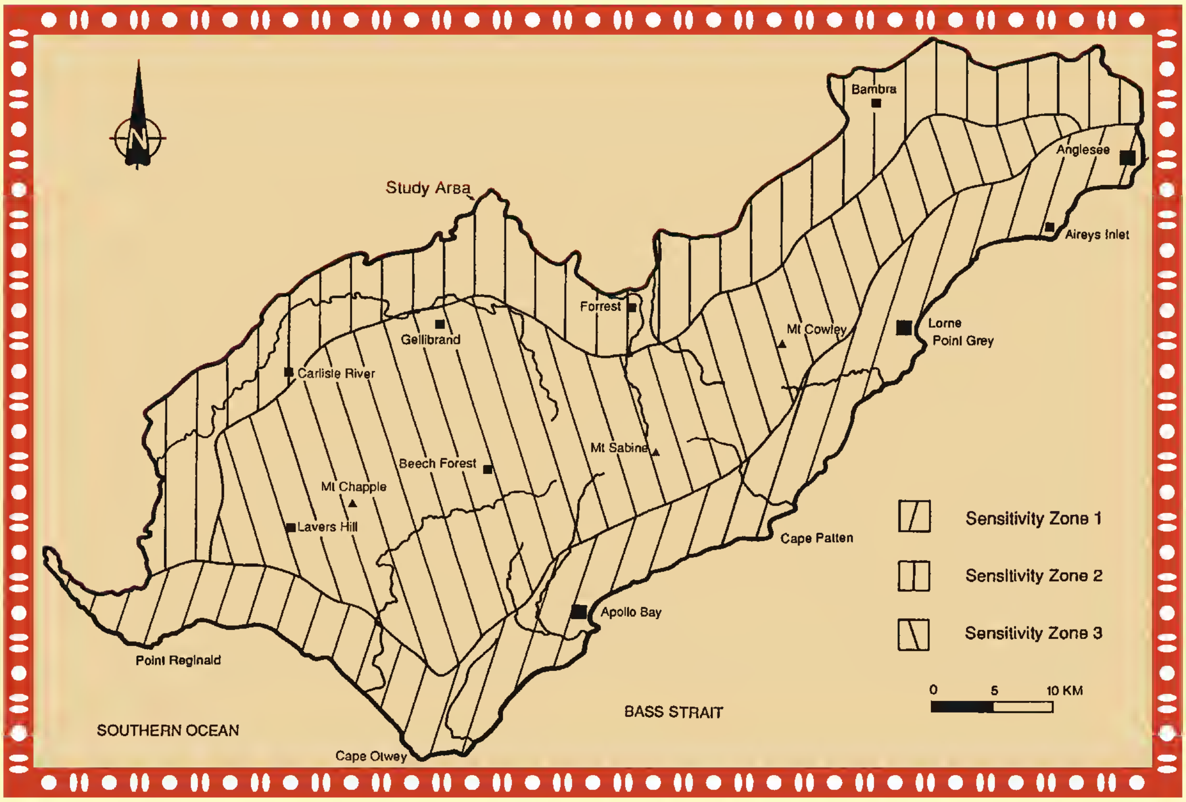
ABORIGINAL
AFFAIRS
VICTORIA

A Predictive Model of Aboriginal Archaeological Site Distribution in the Otway Range



Occasional Report No. 49

Thomas Richards

1998

A Predictive Model of Aboriginal Archaeological Site Distribution in the Otway Range

Occasional Report No. 49

Published by Aboriginal Affairs Victoria, Victorian Government Department of Human Services.
Design and production by Department of Human Services Communications Unit.

(96/0421)

ISBN: 0-7306-5080-4

(1310597)

Contents

Tables

Figures

Abbreviations Used in Text

AAV Aboriginal Affairs Victoria
VAS Victoria Archaeological Survey
LTU La Trobe University
BP Before Present (AD 1950)

Preface

The Otway Survey project was undertaken in 1991 for the Victoria Archaeological Survey (VAS). Field work and a draft report were completed at that time, but circumstances, including the absorption of the VAS into Aboriginal Affairs Victoria, lead to the report lying unrevised for several years. The final draft was completed by the author while working for the Heritage Services Branch of Aborginal Affairs Victoria (AAV) in 1996. Chapter 4, Analysis and Predictive Model, was upgraded with the addition of a statistical analysis of the archaeological density data. This analysis substantiated and refined the interpretation of patterning that was identified in the draft. The remaining chapters were only subjected to minor editing in 1996 and are essentially unchanged since 1991.

Many people contributed to the successful completion of the Otway Survey and I extend my gratitude to the following: Nellie Flagg (Wathaurong Aboriginal Co-operative) and Geoff Clark (Framlingham Aboriginal Trust) for supporting the survey; residents of the Otways for allowing their properties to be surveyed; Hilary du Cros (du Cros and Associates) for providing helpful comments on an early draft of the report; Bob Brinkman (Department of Natural Resources and Environment, Colac) for supplying important information on the environment of the Otway Range.

Former VAS personnel provided information, assistance and advice: Tony Armstrong, Gabrielle Brennan, David Clark, Derek Fowell, Jill Gallagher, Mike Green, Roger Luebbers, Mike McIntyre, Chris Moreira, Jim Rhoads, Stewart Simmons, Iain Stuart, Chris Thomson and Nora van Waarden. Nora van Waarden (Project Manager), Jim Rhoads and David Clark also provided critical comments on drafts of the report that helped to tighten the presentation.

Chris Thomson (VAS), Kathy Travis (Wathaurong Aboriginal Co-operative) and Lionel Harradine (Framlingham Aboriginal Trust) were invaluable field assistants. The shovel test project could not have been undertaken without the hard work of VAS Aboriginal Site Officer trainees Brett Ahmatt, Annette Xiberras and Adam Lovett, their supervisor Caroline Bird, and volunteer Jacinta Donadio.

I thank David Clark (Manager, Heritage Protection Section) and Stewart Simmons (Manager of Archaeological Sciences) for their guidance and encouragement during the final revision and production of this report.

Phillippa Sutherland produced the excellent cover illustration and figures 1–14, 24 and 25.

I am grateful to Maryann McIntyre for her technical edit of the manuscript and for transforming it into Department of Human Services corporate style.

Finally, I thank Iris Lauchland, Chris Williams and Darren Scherger of the Human Services Communications Unit for their dedication to the goal of turning my manuscript into the present volume.

Summary

Introduction

The Otway Survey was a Statewide Survey Program regional archaeological project undertaken by the Victoria Archaeological Survey in 1991. The primary objective of the study was to develop a predictive model of Aboriginal site distribution and density for the Otway Range. A major field survey was carried out between 4 February and 22 March 1991 to gather data for model development. This report presents the field work results, a predictive model, precontact Aboriginal settlement models and cultural heritage management recommendations.

A major aim of the Statewide Survey Program was to provide archaeological and cultural heritage management training and experience for Aboriginal community members. To this end, representatives of the Wathaurong Aboriginal Co-operative and the Framlingham Aboriginal Trust participated in the entire field program as trainee archaeological field assistants. In addition, VAS Aboriginal Site Officer trainees from the Ballarat and District Aboriginal Co-operative, Wurundjeri Tribe Land Compensation and Heritage Council and the Swan Hill and District Aboriginal Co-operative received one week of instruction and experience in shovel test sampling.

Study Area Background

The Otway study area has an area of approximately 2129 square kilometres. The main spine of the Otway Range runs from south-west to north-east at an elevation of about 500 m a.s.l. with isolated peaks up to 675 m. A rolling plateau, ranging from 1–10 km in width, caps much of the range, but it is more extensive on the western half. The slopes of the range extend down to the sea in a series of steep-sided ridges on the south; the ridges merge with gently undulating plains on the north, east and west. Only west of Apollo Bay are there significant coastal plains and these do not exceed 5 km in width.

The main spine of the Otway Range receives up to 2000 mm rainfall per year and the ranges once hosted significant stands of cool temperate rainforest. Over a century of clearing, logging and disastrous human-related fires have severely affected the distribution of native floristic communities.

Most of the study area is within the traditional territory of the Gadubanud tribe, although small parts of the study area fall within the traditional territories of the Girai Warrung, Gulidjan and Wada Warrung tribes. Very little is known about the traditional lifeways of the Gadubanud. The study area is located within the boundaries of two present day Aboriginal communities, the Framlingham Aboriginal Trust and the Wathaurong Aboriginal Co-operative.

Prior to 1991, professional archaeological investigations in the study area consisted of three excavations, three major surveys, one minor survey, a desktop study and the collection of exposed Aboriginal skeletal remains. The majority of previously recorded archaeological sites were located along the coast, which had been the focus of the major archaeological surveys and excavations. Several researchers have produced models of late precontact period (ca. 5000 BP to ca. 150 BP) Aboriginal settlement patterns along the southern periphery of the Otway Range. Their models are summarised, graphically illustrated and assessed in light of the present analysis and predictive model.

Survey Results

The Otway Survey was comprised of two distinct field programs: the main one being a surface survey and the other a brief subsurface survey pilot project involving shovel test sampling. Five weeks of surface survey was undertaken in February and March 1991 with a crew of four persons. Thirty-four survey blocks with an area of 1,854,500 m^2 were examined, resulting in the discovery of 57 artefact scatter sites. In addition, two private artefact collections were recorded. An additional week of shovel test sampling was undertaken in March 1991 with a crew of nine persons, resulting in the discovery of two more artefact scatters.

Site area ranged from 1 to 7200 m^2, with only six sites (10.5 per cent) having areas of 1000 m^2 or greater. All sites were disturbed to some extent, but this was inevitable because the sampling strategy focused on disturbed areas with good surface visibility. The majority of sites (50 or 87.7 per cent) were moderately disturbed, being located on ploughed fields, forest tracks or cleared areas. Sites located on logging coupes (7 or 12.3 per cent) were highly disturbed.

Flaked stone artefacts, ground stone artefacts and clay heat retainers were found, although most sites contained only flaked stone. The quantity of flaked stone artefacts present on sites ranged from one to 100, with only eight sites (14.0 per cent) having ten or more. Simple retouched flakes comprised the majority of tools found, followed by scrapers and microliths. Debitage included flakes, flake shatter, freehand percussion cores, bipolar cores and bipolar flakes. Flaked stone raw materials consisted of silcrete (62.1 per cent), quartz (16.0 per cent), flint (10.0 per cent), quartzite (7.2 per cent), chert (4.1 per cent), chalcedony (0.3 per cent) and unidentified (0.3 per cent).

Quartz and silcrete occur naturally throughout much of the study area, while flint is only found at several locations on the coast. Flint artefacts were present at 17 sites and all but two of these are within 3.3 km of the coast. The remaining two sites are approximately 18 km inland, on the north side of the Otway Range. This indicates possible precontact period Aboriginal population movement across the Otway Range or the exchange of flint from coastal populations to interior populations.

Two undisturbed forested areas, survey Blocks 27 and 28, were selected for subsurface surveying with shovel test sampling. One metre square pits were excavated on a 10 m grid. Aboriginal archaeological sites were found in both shovel test sampling areas. The sites were not detectable on the forest litter obscured ground surfaces. The pilot project successfully demonstrated the usefulness of this technique for discovering shallow subsurface sites.

Analysis

Aboriginal archaeological sites are virtually everywhere in the study area, so the analytical challenge was to identify patterns of differing density. This involved the exploration of relationships between measures of Aboriginal surface archaeological site and artefact density (dependent variables) and environmental attributes (independent variables). A new measure of surface density, archaeological density, was employed in exploratory statistical analyses. The relationships between archaeological density and several environmental variables were investigated, with the following conclusions:

1. Archaeological density is high at distances less than 5 km from the ocean and is much lower at distances of 5 km to 15 km. Archaeological density decreases in a linear fashion with increasing distance up to 5 km from the ocean.
2. Archaeological density in the northern Otway Range is high at distances less than 5 km from the foothill/plain boundary and much lower at distances between 5–11 km.
3. Archaeological density increases up to 200 m elevation and abruptly decreases thereafter to a much lower density level that continues to 500 m elevation.
4. Archaeological density tends to decrease as distance from permanent freshwater increases. Densities are highest within 250 m of water and fall to low levels beyond 350 m distance.
5. Archaeological densities on hills or mountains in the Otway Range are highest on crests and decrease downslope to valley flats or floodplains, which have the lowest density.

Factors influencing site location are, in order of decreasing importance: proximity to an ecotone (i.e. foothills, coastline); proximity to freshwater; elevation below 200 m a.s.l.; and flatness of ground. Late precontact period (5000–150 BP) Aboriginal occupation of the Otway Range appears to have been concentrated on narrow strips along the peripheries of the Range. The central core of the range, including the upper slopes and the plateau, was also visited and exploited by Aboriginal populations but on a much lesser scale than the ecotonal peripheries.

Predictive Model

The above information on site distribution and density is used to develop the predictive model. Three zones of Aboriginal archaeological sensitivity are defined. Each is characterised by a distinct surface site density, artefact density, area occupied by sites, size range of sites and variety and frequency of site types. This information has been synthesised to provide predictive statements on the characteristics of the archaeological record expected to be found in each sensitivity zone.

Sensitivity Zone 1, Southern Periphery of the Otway Range

Sensitivity Zone 1 is considered to have the highest archaeological sensitivity. It extends along the entire coastline from the high-water mark to 5 km inland. Marine shell middens and artefact scatters are the predicted predominant site types expected in this zone, although other types of site will be present in small numbers.

Shell midden sites are expected to be found from just above the high water mark to about 500 m inland, although in areas of coastal plain they may occur at distances of over 2 km inland. Shell midden sites will have areas of up to 50,000 square metres, although most will be considerably smaller. The vast majority will be open sites, but some will be located within rockshelters.

Artefact scatter sites are expected to occur in high densities from about 100 m from the shoreline to over 4 km inland. They will usually consist of flaked stone tools and debitage and will sometimes also include stone axes, grinding stones and heat retainers. Surface artefact numbers can be expected to generally range from 1–175 and surface area from 1–14,000 m^2. Most of these sites will be shallowly buried, their exposure on the ground surface caused by wind or water erosion, or more usually, by recent human activities.

Expected Aboriginal archaeological surface densities within Zone 1 are very high, averaging 30 sites/km^2 and 150 artefacts/km^2. Archaeological sites are predicted to occupy 4 per cent of the surface area of Zone 1. Artefact scatter sites are predicted to be predominantly located on coastal plains and the crests of hills and ridges rather than slopes, valley flats and floodplains. Shell midden sites are predicted to be concentrated along the shoreline, but their distribution will extend further inland where broad coastal plains occur.

Sensitivity Zone 2, Northern Periphery of the Otway Range

This zone consists of a 5 km wide strip along the north, north-west and north-east periphery of the Otway Range. It encompasses the low foothills and the beginning of the steeper slopes of the Range, as well as several large floodplains.

It is predicted that most sites will be artefact scatters with flaked stone artefacts predominantly made of silcrete and quartz, although small amounts of quartzite, chert, chalcedony and coastal flint will also sometimes be present. It is expected that ground stone tools will also sometimes be found at these scatters or occasionally on their own. Artefact scatters in Zone 2 can be expected to range in surface area from 1–4000 m^2 and contain from 1–75 surface artefacts. Small numbers of other site types will also be present.

The expected Aboriginal archaeological surface density in Zone 2 is 25 sites/km^2 and 200 artefacts/km^2. Archaeological sites are predicted to occupy 1 per cent of the surface area of this zone, with the highest densities predicted to occur on the crests of ridges and hills.

Sensitivity Zone 3, Interior of the Otway Range

This zone consists of the uplands of the Otway Range. Artefact scatter sites are the predicted predominant site type, although small numbers of other types will also be present. Artefact scatters are expected to range from 1–200 m^2 in surface area and contain up to ten surface artefacts. These will be mainly comprised of flaked stone artefacts made on silcrete or quartz, although ground stone artefacts may occasionally be present.

Aboriginal archaeological surface density is predicted to be consistently low throughout Sensitivity Zone 3, with 20 sites/km^2 and 50 artefacts/km^2 expected. Sites are predicted to occupy less than 1 per cent of the surface area of this zone, with the highest archaeological densities expected along the tops of ridges.

New Aboriginal Settlement Pattern Models

The models presented below are descriptions of settlement patterns of societies with economic organisations that are essentially those of 'foragers' (Binford 1980). The models are therefore based on the assumption that most economic activity occurs while people make day-trips from residential bases to hunt or collect food and other resources within a typical 10 km foraging radius (Jarman 1972). They are intended as points of departure for future research, rather than as ends in themselves.

Model 1

The coastal peripheral area was occupied year-round, with residential moves parallel to the coast. A 10 km foraging radius would include substantial areas of littoral, coastal scrubland/plain and lower Otway slopes. Many small to medium shell middens may represent littoral and marine resource extraction locations and, occasionally,

field camps/locations. A relatively high density of small artefact scatter sites throughout this area reflects locations where terrestrial resources were obtained and possibly field processed. A low density of artefact scatters in the inner Range represents the infrequent use of this area for terrestrial resource extraction, possibly mainly for technological plant species.

Two types of probable residential sites are apparent. Large shell middens with diverse contents are one type and medium to large artefact scatters, also with diverse contents, are the other. Shell middens are located on or close to the coast, while the large artefact scatters tend to be located up to a maximum of about 5 km from the coast. Assuming some contemporaneity between these two types of site, an assumption partially supported by microlithic tools being found at both types, they may represent differing seasonal patterns of occupation.

The northern peripheral area with high site density results from two likely sources, both unrelated to the settlement system evident on the southern edge of the Otway Range. It is possible, but not very likely, that a permanent population occupied this periphery. If this was the case, the site distribution would again suggest a residential base movement parallel to the edge of the Range. Residential sites may well have been located approximately 1–3 km within the Ranges so that a foraging radius would include ecotonal foothill-woodland/plain-grassland resources and forest resources. The other possibility is that the above described pattern is only one seasonal component in a system that includes other heavily exploited areas, possibly around lakes Colac and Corangamite and the Barwon River valley.

Model 2

The coastal peripheral area on the southern edge of the Otway Range represents one seasonal component of an Aboriginal settlement/economic system that included a move to the northern periphery of the Range. In this scenario, the variability in coastal residential sites may still be seasonal but may represent fine-grained seasonal differences rather than a simple spring-summer vs. fall-winter dichotomy. Otherwise, the coastal foraging pattern would be similar to that of Model 1. Similarly, the pattern described in Model 1 for populations with residential camps just inside the foothills of the Range would be the same for this model. Again, it is possible that at least one other seasonal move to a distinct environmental zone may be involved. The system could well have included seasonal visits to environmentally diverse areas such as the southern Otway coast, the northern Otway foothill-woodland/plain-grassland ecotone to the north, and lakes and rivers on the volcanic plain-grassland.

While the above models are intended to characterise late precontact period (ca. 5000–150 BP) Aboriginal settlement patterns, neither can be attributed to the Microblade or Post-Microblade periods with any degree of certainty. It is possible that each model may approximate the settlement movements of contemporaneous Aboriginal groups occupying different parts of the Otway Range. Another possibility is that Model 1 generally approximates the settlement pattern of Aboriginal populations, except under certain circumstances of resource stress, when a pattern more like Model 2 was adopted.

Aboriginal Cultural Heritage Management

Including the sites found during the Otway Survey, there is a total of 276 recorded Aboriginal archaeological sites in the study area, falling into nine site types. Archaeological significance is assessed for this sample of sites on the basis of four surface attributes of each site and one attribute of each site type. The overall results for the study area are: high significance—60 sites (21.70 per cent of total); moderate significance—190 sites (68.80 per cent);

low significance—19 sites (6.90 per cent); unrated (non-sites, collections, sites lacking data)—7 sites (2.50 per cent).

Shovel test sampling is a method of subsurface surveying that should be employed in cultural heritage management situations where limited areas with low surface visibility must be assessed before disturbance. For example, a shovel test sampling program could be applied to a proposed logging coupe that has the potential to contain Aboriginal archaeological sites. The result of a properly applied shovel test sampling survey would be a clear picture of the number, location and characteristics of Aboriginal archaeological sites in the proposed coupe prior to logging. Appropriate management decisions could then be made on an informed basis.

Information presented in this report, particularly the predictive model and the significance assessment, can be used by Aboriginal communities, local and state government planners and AAV to avoid or minimise impacts on archaeological sites. Potential developments can be easily plotted on the Archaeological Sensitivity Zone map for a preliminary assessment of the likely impact of such projects to alert planners of the necessity of having archaeological impact assessments undertaken. Aboriginal archaeological sites are afforded statutory protection under the (Commonwealth) *Aboriginal and Torres Strait Islander Heritage Protection Act* 1984 and the (Victorian) *Archaeological and Aboriginal Relics Preservation Act* 1972. There are severe penalties under both Acts for the unauthorised disturbance of Aboriginal sites.

Archaeological Sensitivity Zones 1 and 2 are of high archaeological sensitivity and any land-altering activities should be subject to impact assessment prior to commencement of ground disturbance. Land-altering activities are less likely to impact sites in Zone 3 than in the other two zones; however, there is still a considerable threat to sites from large-scale disturbances (i.e. logging or agricultural land clearance). Ridge tops should be avoided (except those logged within the past forty years) as this is where the highest densities of sites are present.

1. Introduction

The Otway Range of the Victorian central coast was virtually *terra incognita* to archaeologists in early 1991 (figure 1). Survey and excavation in the region had been largely confined to the coastal strip (figure 2). A systematic regional study was badly needed and the VAS employed the author to direct such a project under the *Statewide Survey Program*. This program, initiated in 1989 by the Victorian State Government, was designed to fill gaps in regional archaeological knowledge and to provide cultural heritage management training for Aboriginal people.

The primary objective of the Otway Survey was to produce a predictive model of Aboriginal site distribution and density. In addition, the following subsidiary objectives were specified in the Project Brief:

a. To locate, document and interpret the Aboriginal archaeological sites of the study area.

b. To assess the significance of the identified archaeological sites.

c. To identify areas of high archaeological potential within the study area.

d. To assess the implications that the archaeological sites of the study area may have for development in the area and provide recommendations for the management of those resources.

e. To consult with Aboriginal people with interest in the study area to obtain their views regarding the cultural heritage of the area.

f. To provide training for Aboriginal groups and individuals in cultural resource surveys, resource management and heritage legislation.

Field survey was undertaken between 4 February and 22 March 1991; analysis and report writing took place from the completion of field work until October 1991. This report presents the field work results, a predictive model, precontact Aboriginal settlement models and cultural heritage management recommendations.

The report consists of six chapters. Chapter 2 provides background information on the environment, ethnohistory and previous archaeological research in the study area. Chapter 3 reports on the survey itself, including strategy, methods and results. Chapter 4 is comprised of two parts—the first analyses the relationships between site density and environmental variables, and the second part is the predictive model, based on that analysis. Chapter 5 discusses precontact Aboriginal settlement patterns in the study area. Aboriginal cultural heritage management recommendations are presented in Chapter 6. A gazetteer of all known sites in the Otway Study Area is included as an appendix.

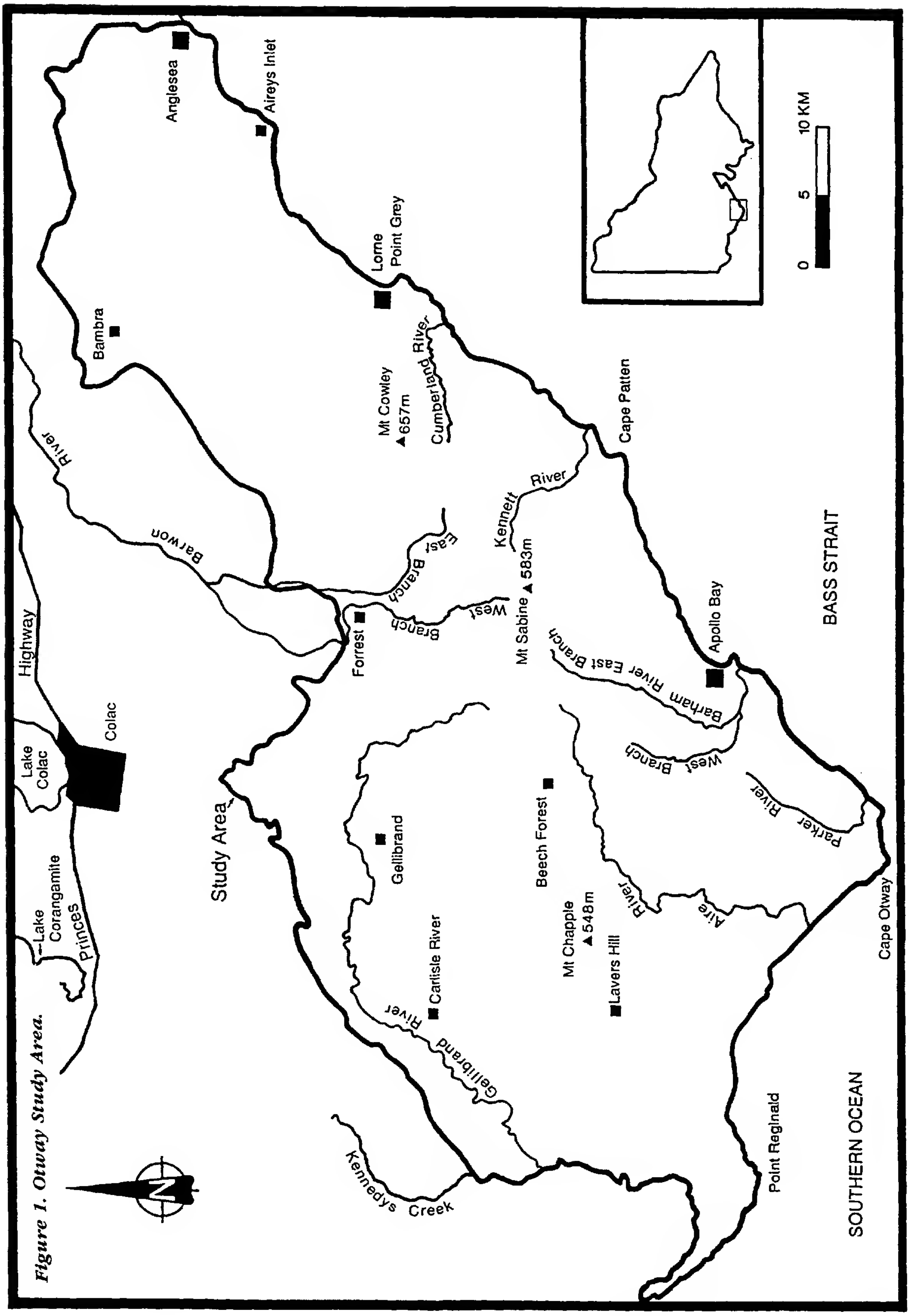


Figure 1. Otway Study Area.

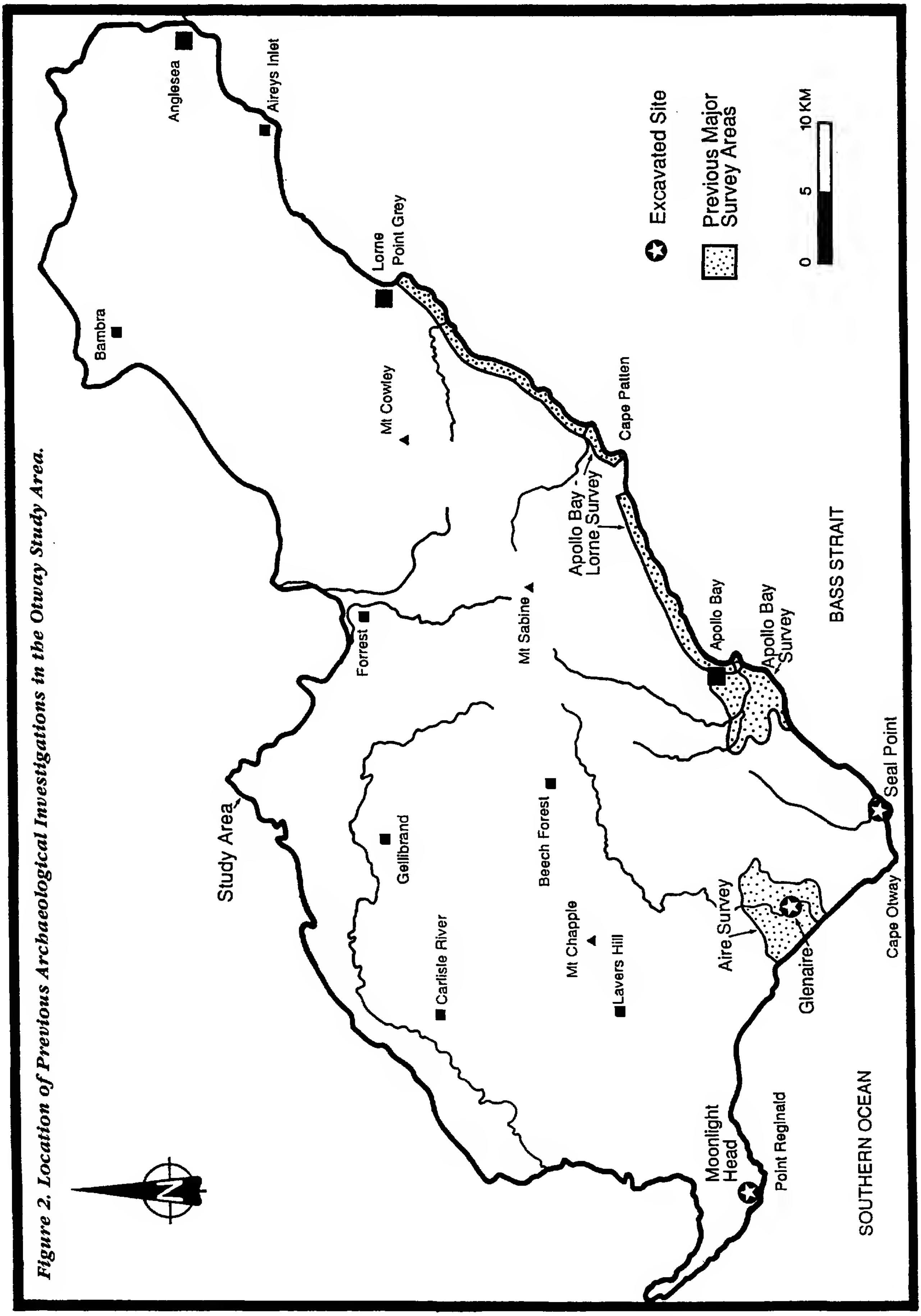


Figure 2. Location of Previous Archaeological Investigations in the Otway Study Area.

2. Background

Otway Study Area Description

The Otway Study Area consists of the Otway Range and foothills. It measures 100 km south-west to north-east, varies from 15–40 km south-east to north-west and has an area of approximately 2129 km^2 (figure 1). The south-western boundary is the mouth of the Gellibrand River and the southern boundary follows the high tide mark of the Southern Ocean from the Gellibrand east to Anglesea. From Anglesea, the boundary runs north along the periphery of the foothills and closely follows the line of the foothills' edge to the west and south-west to just north of Forrest. The foothills' edge was less clear-cut west and south-west of Forrest, resulting in a somewhat arbitrary boundary. The western boundary follows lower Kennedy's Creek down to its confluence with the Gellibrand River and south along the latter to its mouth.

The main spine of the Otway Range runs from south-west to north-east at an elevation of about 500 m a.s.l. with isolated peaks of up to 675 m. A rolling plateau, ranging from about 1 km to 10 km in width, caps much of the range, but is more extensive on the western half. The slopes of the range extend down to the sea in a series of steep-sided ridges on the south; ridges merge with undulating plains on the north, east and west. Only west of Apollo Bay are there significant coastal plains and these never exceed 5 km in width. The distribution of major landforms in the study area is illustrated in figure 3.

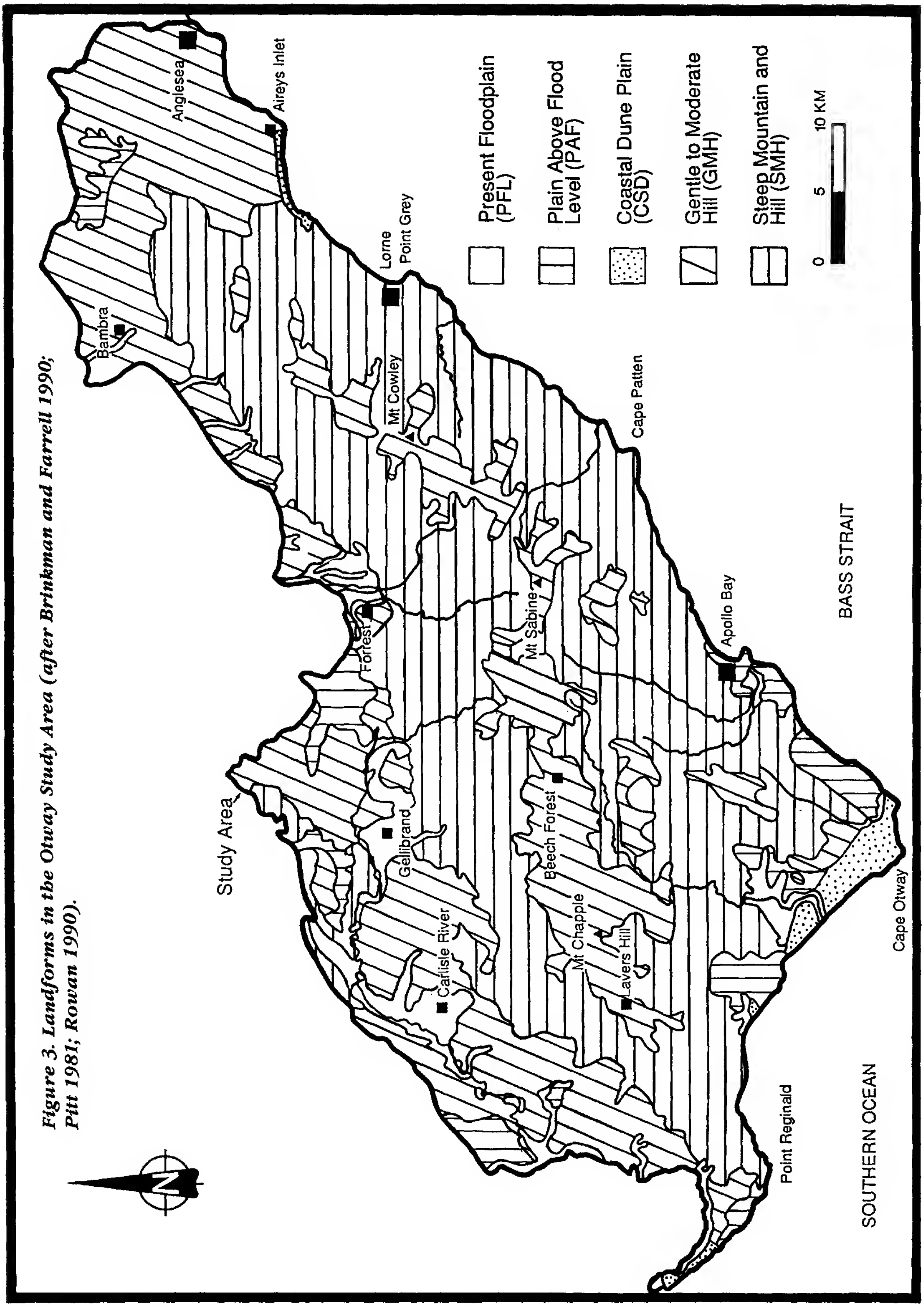
The main spine of the Otway Range receives up to 2000 mm in rainfall per year, but this amount drops off significantly to landward and in some places halves within 10 km (Pitt 1981:2). Most rain falls between May and September, the wettest month being August and the driest January (Brinkman and Farrell 1990:3). The warmest months are January and February with average maximum temperatures of 20°C on the coast. Average mid-winter temperatures are 3–4° C with temperatures at higher altitudes being lower year-round (Brinkman and Farrell 1990:3). Winds are north-westerly to westerly in winter, while weaker easterly and north-easterly winds predominate in summer (Brinkman and Farrell 1990:5).

The Otway Range is mainly comprised of Lower Cretaceous sedimentary rock capped with less than 2 m of strongly acid, well-drained, brown gradational soils (Brinkman and Farrell 1990:11; Pitt 1981:15). Some peripheral portions of the study area, particularly in the west, consist of undulating Tertiary marine sediments with sandy duplex soils (Brinkman and Farrell 1990:7,11).

There is currently a diverse and complex pattern of floristic communities in the study area (Brinkman and Farrell 1990:25–33). Over a century of logging, clearing and disastrous human-related fires have affected the distribution of these communities. No attempt is made here to reconstruct the pre-European floral situation. Notable floristic communities include: Cool Temperate Rainforest, Wet Sclerophyll Forest, Damp Sclerophyll Forest, Dry Sclerophyll Forest, Foothill Forest, Grassy Forest, Coastal Woodland, Heathy Woodland, Riparian Fern Scrub, Estuarine Sedgeland, Reedswamp, Coastal Heath, Coastal Dune Grassland/Shrubland, Foredune Vegetation and Bracken Scrub (Brinkman and Farrell 1990:25–31; Lunt 1989).

Four species of mammals formerly present in the study area are locally extinct: Tasmanian pademelon, common wombat, dingo and eastern quoll (Brinkman and Farrell 1990:43). There are 38 species of mammals still present in the study area, 123 species of birds, 20 reptiles and 10 amphibians (Brinkman and Farrell 1990:table 9). Mammals consist of seven arboreal species, 11 bats, three large terrestrial species, 15 small terrestrial species and two aquatic species (Brinkman and Farrell 1990:44). Mountain forest is the preferred habitat of eight species,

Figure 3. Landforms in the Otway Study Area (after Brinkman and Farrell 1990; Pitt 1981; Rowan 1990).



including the swamp wallaby, common ringtail possum, eastern pygmy possum, dusky antechinus and tiger quoll (Brinkman and Farrell 1990:45). Foothill forests contain a greater diversity of species than the mountain forests and include eastern grey kangaroo, red-necked wallaby, common brushtail possum, fat-tailed dunnart and sugar glider. Heathy woodland is the favoured habitat of six small terrestrial mammal species.

The many small, fast-flowing, highly oxygenated creeks in the study area contain 14 species of native fish and three species of eel (Brinkman and Farrell 1990:52). Gellibrand and Aire rivers are notable for species diversity.

Ethnohistory

There is no ethnography of Aboriginal people occupying the study area, forcing a reliance on very scanty historic records for reconstructions of Aboriginal culture at the time of early European contact. Ethnohistoric and ethnographic information from outside the study area supplement this meagre database. Several authors have recently summarised, interpreted and interpolated historic documents pertaining to Aboriginal occupation of the study area in the first half of the 19th century (e.g. Scarlett 1977; Stuart 1981; Chadzynski 1981; Clark 1990).

Language and Clan Distribution

The estimated boundary of speakers of the Gadubanud ('King Parrot') language or dialect (Clark 1990:185–191) corresponds closely to the boundary of the Otway Study Area (figure 4). The Study Area also partly lies within the traditional territory of the Girai Warrung, Gulidjan and Wada Warrung speakers (figure 4). Gadubanud may be a dialect of the Gulidjan language, whose speakers were located immediately north of the Gadubanud, but its linguistic affiliation must remain uncertain (Clark 1990:186).

The estimated boundaries of Gadubanud territory are the Gellibrand River in the west and north-west, the Barwon River from Forrest to Birregurra in the north-east and a line between Birregurra and Airey's Inlet in the east (Clark 1990:figure 7). Historical references mention only four clans and the approximate location of their estates: one north of Moonlight Head and three near Cape Otway (Clark 1990: 190–191). A possible fifth clan estate is located at the 'east head of the Barwon River, twelve miles south of Birregurra' in the northern foothills of the Otway Range (Clark 1990:191). However, the affiliation of the 'Yan Yan Gurt tribe' as a clan of the Gadubanud by Clark has to be considered speculative on the basis of the information he cites (e.g. Armytage in Bride 1898). It is of significance that none of the known or possible clan estates of the Gadubanud are located deep within the Otway Range. This supports Smyth's view that '...it is scarcely probable that any tribe would live in the denser parts [of the Otway Range] from year to year' (Smyth 1878:34).

Culture, Seasonal Movement and Economy

Virtually nothing is known about the culture, economy and seasonal movements of the Gadubanud. Clan organisation is not described, but may have been similar to that of the possibly linguistically related neighbouring Gulidjan, who were divided into two matrilineal moieties (Clark 1990:222).

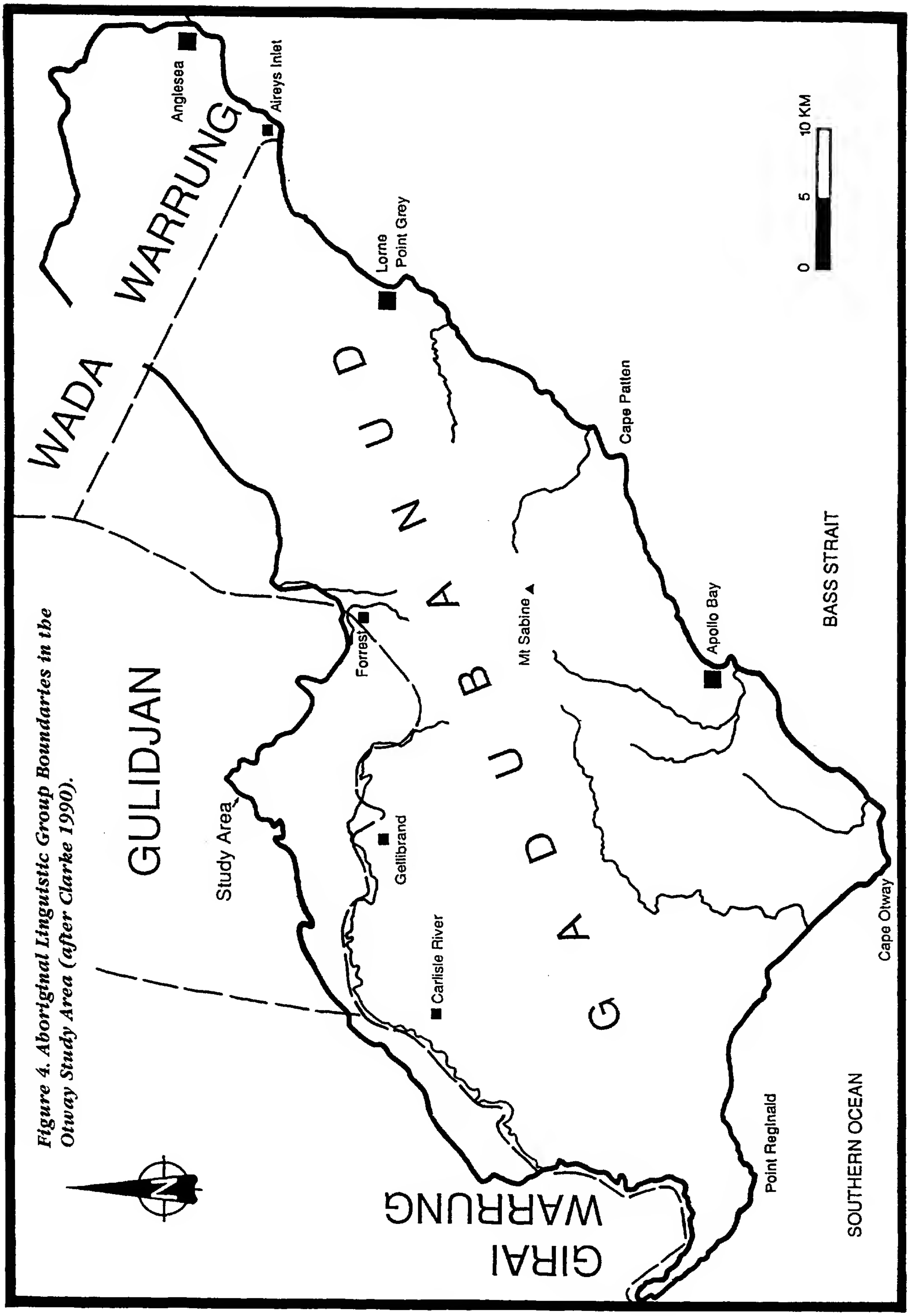


Figure 4. Aboriginal Linguistic Group Boundaries in the Otway Study Area (after Clarke 1990).

Scarlett (1977) offered a largely speculative reconstruction of Aboriginal population distribution, seasonal movements and resource use based on scant ethnohistoric data fleshed out with general ethnographic information, current plant and animal resource distributions, and even the distribution of archaeological sites. Regarding seasonal population distribution in the Otway region, Scarlett (1977:3) suggested:

> ...the bulk of the permanent population of the region would have been found along the coast...The inland forests were probably occupied on a seasonal basis by families which spent the bulk of the year at the larger population centres, either on the coast or in the Basalt Plains Region.

Chadzynski (1981) presented essentially the same model of population distribution as Scarlett, although he did suggest the possibility that the Gadubanud occupied the coast permanently.

Scarlett proposed the following reconstruction of Gadubanud economy:

> The economy of the coastal groups was based on shellfish collection and fishing in the tidal estuaries, supplemented by plant foods collected from the land, particularly on the river flats and swamps: eg. The tubers of Water-ribbons (*Triglochin procera*), the rhizomes of the Tall spike-rush (*Eleocharis sphacelata*), and the tubers of the Club-rush (*Scirpus maritimus sensu lato*) (Scarlett 1977:3).
>
> The more open forests and the heaths would be used most intensively, particularly around river flats and swamps...Within the forest koala, possum and wallaby were hunted, the latter with 'dogs and spears' (Dawson 1881), and probably with the aid of extensive fires. Vegetable food was derived mainly from species from wet places... The relatively low animal populations and difficulty of movement probably restricted utilization of the tall open forests in the wetter parts of the Ranges. However the utilization of the pith of tree ferns as a carbohydrate source is reported from other areas of Victoria, and Aboriginal groups may have deliberately penetrated the forests to exploit stands of these species (Scarlett 1977:4).

Scarlett (1977:4) also identified the Otway forests as a probable source of raw materials for technological items involved in trade. These included the 'rare and valuable' bandid spears (probably made from *Phebalium squameum*), narmal light spears, made from grass-tree stalks (*Xanthorrhoea sp.*) and dealwark firesticks of Austral Mulberry (*Hedycarya angustifolia*).

Previous Archaeological Research

Portions of the Otway Study Area have been the subject of professional archaeological investigations over the last 30 years. The area has also been well picked over by artefact collectors (du Cros 1990:24–25). Professional investigations are reviewed below and lead to a discussion of previous models of precontact Aboriginal settlement and land use patterns in and around the study area. Finally, the existing archaeological site database is assessed.

Surveys

Previously, three major surveys have been undertaken in the study area (figure 2). Stuart (1979; Head and Stuart 1980) conducted a detailed survey of the Aire River basin in the late 1970s. Witter (n.d.) undertook a survey for the VAS that focused on the Apollo Bay coastline and Barham River basin, although a few of his sample units were located on Cape Otway and the plateau and south slopes of the Otway Range. Finally, a La Trobe University Archaeology Department training exercise held in 1988 for second year students involved the systematic survey-

ing of all terrain between the Great Ocean Road and the high-water mark from Apollo Bay to Lorne (a strip averaging about 50 m wide) (LTU n.d.). This project has not been formally written up, forcing a reliance on site record cards and student essays for information.

Three additional studies by the VAS merit mention. The first is a minor survey of the Otway Range undertaken by Presland (1982) during which three isolated artefact sites were recorded. He explained the small number of sites found as follows:

> Throughout the study area there were few localities where ground surface conditions were such as to allow effective examination. That land which is not used for farming, i.e. the higher elevations and land with steep inclines, supports a forest regime with a thick understorey. In many parts this is regrowth after past clearing but nonetheless surface visibility is usually less than five percent. There are large areas of pine plantation but within these the surface is similarly obscured by debris. Within those parts of the survey area where farming and grazing are practiced [sic], in the lower elevations, along the major water courses and on less inclined land, there is often thick coverage of grass which drastically reduces surface visibility. These factors mitigated against effective site detection in the study reported here and point to the efficacy of surveys carried out at periods following ploughing of fields or other clearance of vegetation (Presland 1982:9).

Du Cros (1990) produced a desktop study which collated existing archaeological, ethnohistorical and environmental data and references pertinent to the study area. Her report, which was specifically intended to provide background and guidance for the present study, also included a preliminary predictive model and draft survey strategy. In addition, she provided a summary of artefacts from private collections that originated in the study area and are now held in the Museum of Victoria. While the survey strategy and predictive model in the present study differ in emphasis from those suggested by du Cros, her work was a very useful starting point for this project.

Finally, VAS collected exposed Aboriginal skeletal remains from burials that had been completely disturbed by quarrying at the Hordern Road site between 1981 and 1983 (Clark 1983). At least three individuals were represented by the recovered skeletal material (Clark 1983).

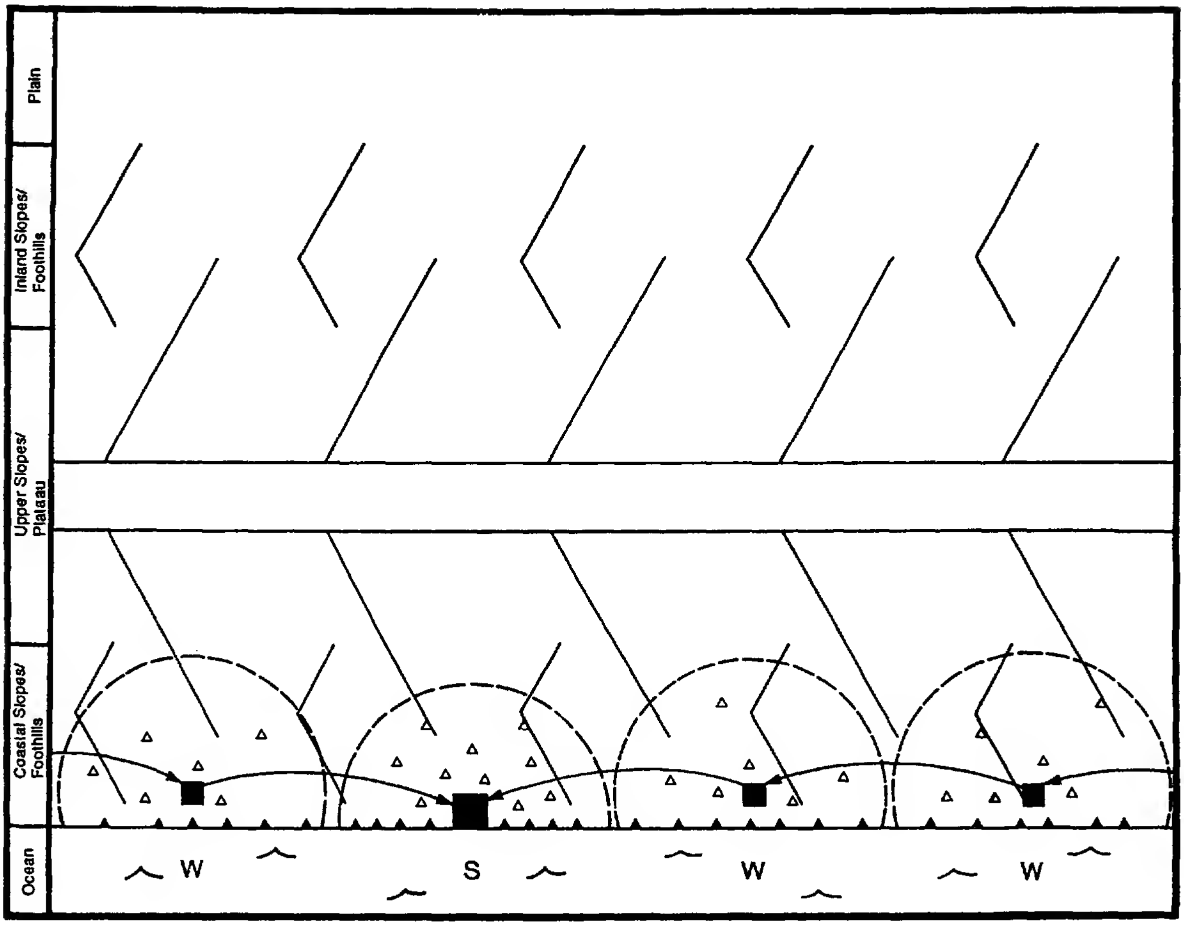
Excavations

Three sites have been completely or partially excavated in the study area (figure 2). The results of these investigations are described below.

The earliest excavations in the Otway Range were undertaken by Mulvaney (1962) at Glen Aire Rockshelters I and II. Glen Aire Shelter I was very disturbed and provided little useful information. The nearby Glen Aire Shelter II contained a variety of cultural remains in an undisturbed context. The contents of the shelter have been studied in detail by Fullagar (1982) and his thesis is used here as the source of information on this site.

The site is a small rockshelter located on a steep scarp approximately 150 m west of the Aire River and 1.8 km north of the ocean. Eleven square metres of deposit, with a volume of approximately 14 m^3, were excavated, revealing stratified deposits rich in freshwater and marine shellfish remains, animal bones and lithic artefacts. A human skeleton, identified as the remains of an Aboriginal male who died in his early twenties, was also found. A single radiocarbon date of 370 BP derived from material within the cultural deposit was considered to support an estimated 600 year long occupation span for the site.

Figure 5. The Lourandos Aboriginal Settlement Pattern Model (Lourandos 1980).



Large Residential Base

Residential Base

Littoral and Marine Resource Extraction Location

Terrestrial Resource Extraction Location

Wetland Resource Extraction Location

Foraging Radius Around Residential Base

Wetland

Human Population Movement

S Spring - Summer Occupation

W Autumn - Winter Occupation

Fullagar concluded that the nature of occupation of the rockshelter changed through time. He based his interpretation on a study of the microwear traces on flint artefacts found at the site, supplemented with analysis of lithic technology, bone technology and faunal remains. Initially, the rockshelter was probably a temporary summertime camp inhabited by small groups of people. More recently its use became specialised, mainly involving bone point manufacturing in winter and spring by people who lived at a nearby base camp.

Seal Point, near the southernmost tip of Cape Otway, is a large open midden excavated by Lourandos in the mid-1970s (Lourandos 1980, 1983). The site has an estimated area of 40,000 m^2, of which 13 m^2 were excavated and even less was analysed. Four radiocarbon dates from 1420–270 BP indicate the span of known occupation of this stratified midden (Mitchell 1988:14). Occupation is estimated to have ended just prior to European contact.

Lourandos focused his excavations on an area of shallow, circular, surface depressions which he interpreted as the remains of hut pits. He found hearth features, bone implements, flaked stone tools and waste, ground stone implements, abundant marine shellfish remains, sea and land mammal bones and fish bones. Notable is a greenstone axehead which originated from a source on the Hopkins River near Berrambool.

The site is interpreted as spring–early summer semi-sedentary base camp. The occupants had a 'broad and intensive marine-terrestrial economy' (Lourandos 1980), although shellfish were the single most important food source. There was an increase in reliance on fish and terrestrial mammals at the expense of seals in the later stages of occupation.

Moonlight Head midden, located near the western end of the study area, is the most recently excavated site (figure 2) (Zobel 1982; Zobel, Vanderwal and Frankel 1984). It consists of a remnant stratified shell midden in a rockshelter which is occasionally scoured by the sea. A largely internally consistent range of radiocarbon dates indicate occupation between 1030 and 180 BP. The inventory of artefacts and faunal remains here is similar to that at other excavated sites. Shellfish was the most important component of the subsistence economy, with *Subninella* dominating early periods of occupation and *Brachidontes* later ones. As at Seal Point, there is an increase in emphasis on land fauna from the earlier to later occupations.

Zobel cautiously interprets the remains from Moonlight Head. The timing of site occupation is not clear and may have been any time of the year. Early in the site's history it may have functioned as a dinnertime camp—a place where locally collected resources were cooked and consumed. Later on it may have functioned as a temporary camp.

Late Precontact Aboriginal Settlement Models

Lourandos, Stuart and Witter have offered differing views on late precontact period (ca. 5000 BP to ca. 150 BP) settlement patterns within the Otway Region. Illustrations have been prepared of the settlement pattern models in which they are presented in standardised schematic fashion (figures 5–9). This has meant making a few interpretations and assumptions regarding certain aspects of the written descriptions of the models, particularly with the addition of a daily foraging radius around base camp locations and the plotting of associated resource extraction locations (Jarman 1972; Binford 1980).

Lourandos derived his model for Post-Microblade period Aboriginal settlement patterns from three sources: his general coastal economic cycle model for Western Victoria; his analysis of Seal Point archaeological remains; and

Figure 6. The Stuart Aboriginal Settlement Pattern Model, Version 1 (Stuart 1979; Head and Stuart 1980).

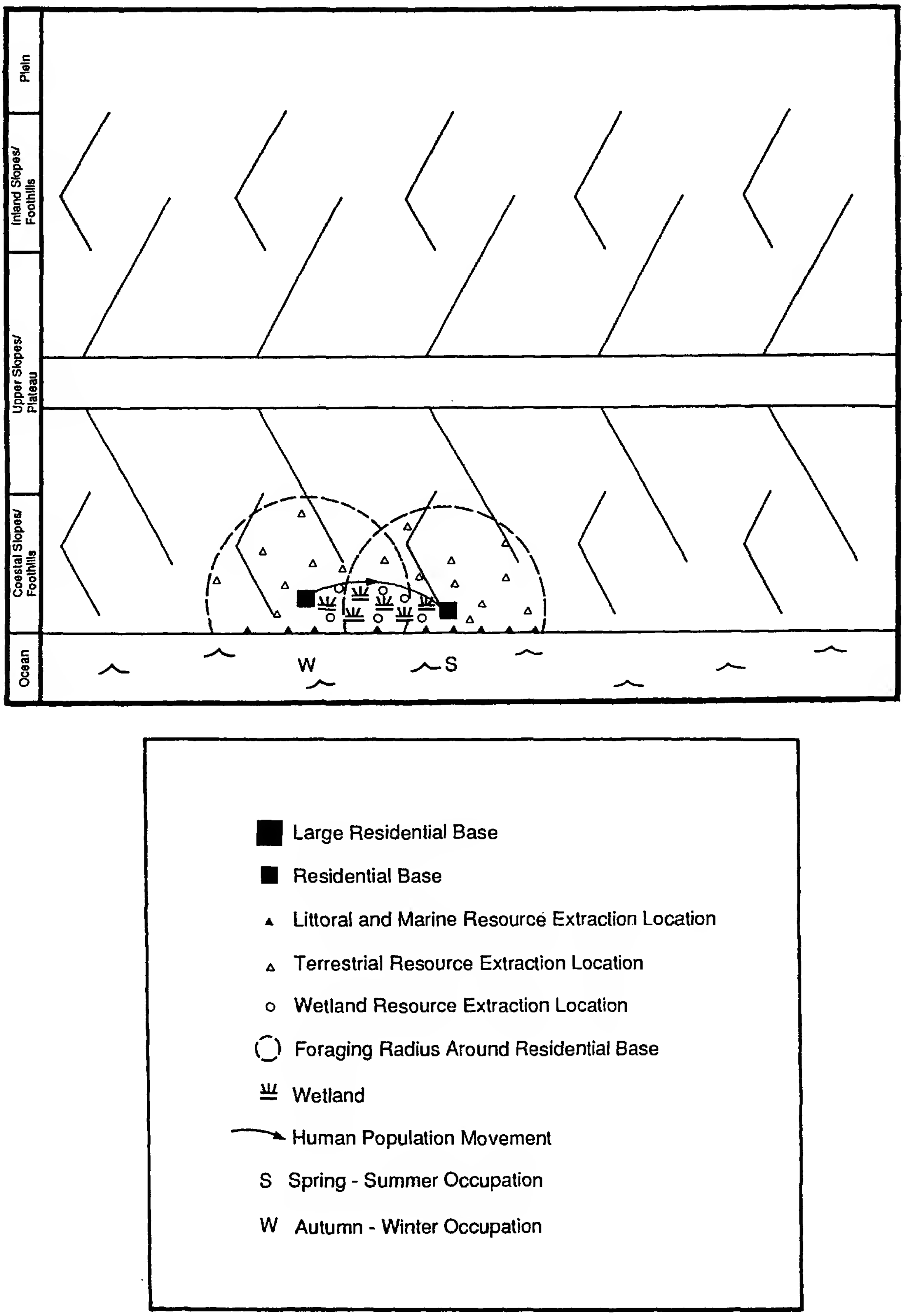
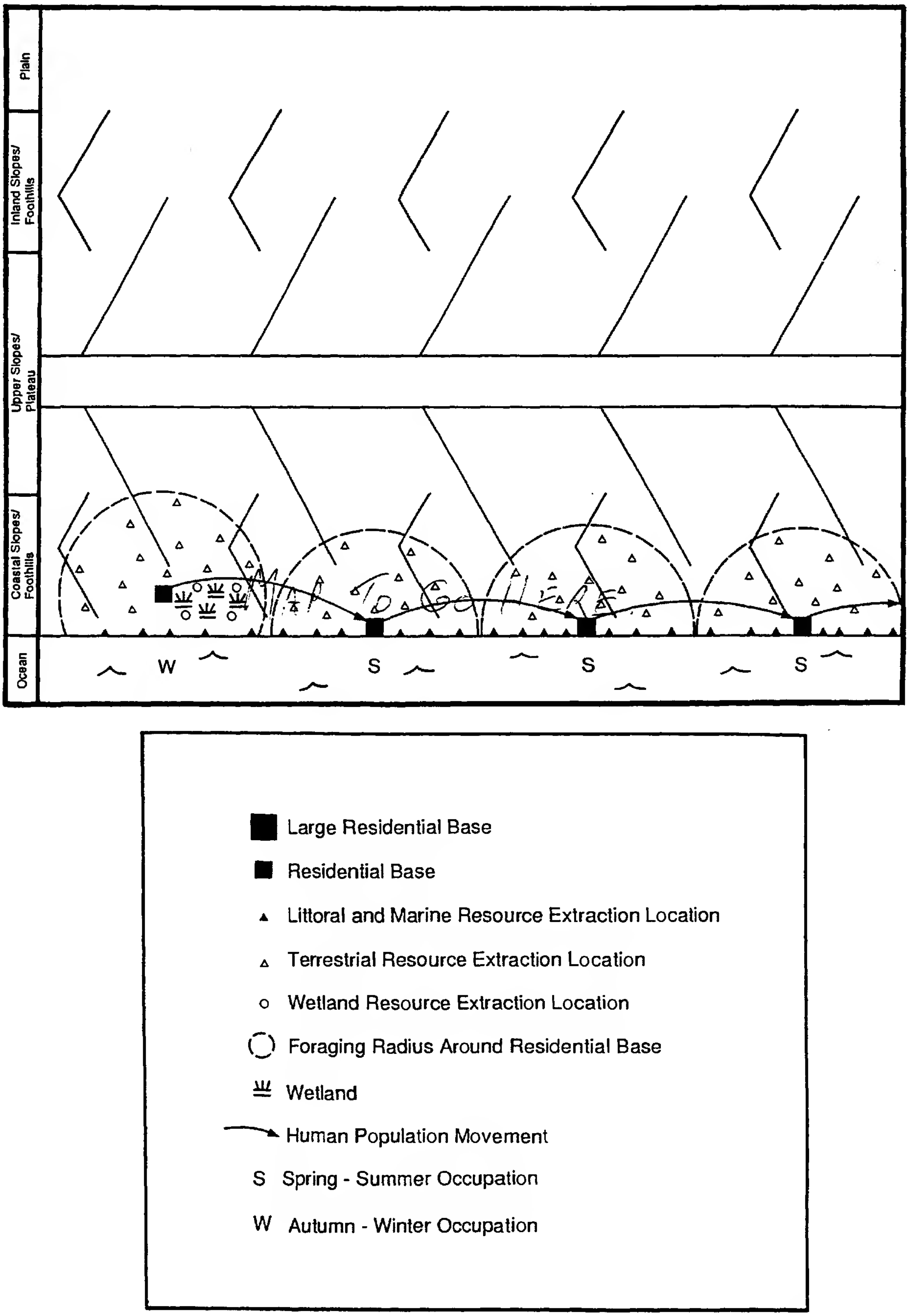


Figure 7. The Stuart Aboriginal Settlement Pattern Model, Version 2 (Stuart 1979; Head and Stuart 1980).



his review of ethnohistoric data and modern food resource distribution and seasonal availability in the area (Lourandos 1980, 1983) (figure 5). He concluded:

> Settlement in the Otway area is restricted by the Otway Ranges and would therefore have been tightly coastal. The Otway rainforest, offering low yielding and dispersed resources would have also posed a limit on settlement...Annual movement would therefore have taken place, we can presume, along the coastline, especially in spring–summer with winter refuge being sought in protected bays and estuaries such as Johanna River, the Aire River, the Parker River and Apollo Bay. From these protected winter bases sorties could have been made to lucrative coastal resource areas, such as Seal Point and other areas (Lourandos 1980:296).

Lourandos elaborated further and proposed that Aboriginal groups were largely sedentary in spring and summer when they occupied large base camps along the coast and focused their subsistence activities around shellfish and plant foods supplemented with land mammals and fish. In fall and winter, people became more nomadic and tended to be dispersed along the coast in small camps located in sheltered areas.

Stuart (1979:55–59, 87–89) postulated Aboriginal settlement models for the Aire River estuary locality (figures 6, 7). He based them on climatic data, seasonal distribution of resources and general ethnographic-ethnohistoric Aboriginal resource exploitation patterns. He considered that high rainfall, low temperatures and low resource productivity in winter would render the uplands uninviting to Aboriginal habitation. Moreover, coastal resources were also less abundant or unavailable at this time of year. Stuart concluded that only wetlands have peak resource productivity/availability in winter and such localities would form the focus for Aboriginal settlement. If a location such as Glen Aire were chosen, there would be several additional productive environmental zones nearby (i.e. the coast and foothills) to provide supplementary food resources. For spring–summer, Stuart suggested two options. The first involved continued occupation of the wetlands, but with a relocation of the base camp because local resources may have been depleted during winter (figure 6). The second suggested a spring movement to the coast where a marine-oriented economy would be practised throughout spring and summer (figure 7). Frequent movement of camp locations along the coast was suggested. The Otway Range would also be exploited at this time of year, but to a lesser degree.

Witter (n.d.) used his analysis of four variables observed at Apollo Bay sites (site location, stratigraphy, midden contents and lithic technology) as a basis for proposing 'highly tentative' Aboriginal settlement pattern models for the Microblade period (ca. 5000–2000 BP) and Post-Microblade period (ca. 2000 BP to European contact) (figures 8, 9).[1] Microblade period settlement involved seasonal movements between the coast and inland areas north of the Otway Range (figure 8). Witter proposed that the coastal zone was most productive during spring and summer because of abundant plant foods and easily exploited shellfish resources. As well, he postulated an emphasis on hunting land mammals in this period, based largely on his belief that microliths were parts of hunting implements. This, in turn, led Witter to suggest that the key factor influencing base camp location was an area's hunting potential. Middens were viewed as the remains of 'dinner-time camps', while artefact scatter sites further inland (but still close to the coast) were judged to be the remains of 'domestic' camps.

In Witter's (n.d.) model, winter was a time of low productivity for food resources on the coast and the ranges. This situation prompted population movement to the north side of the Otway Range. Two possible locations for winter base camps were suggested: the Barwon River valley (although within or outside the Otway Range is not stated) and the Lake Corangamite area.

Figure 8. The Witter Microblade Period Aboriginal Settlement Pattern Model (Witter n.d.).

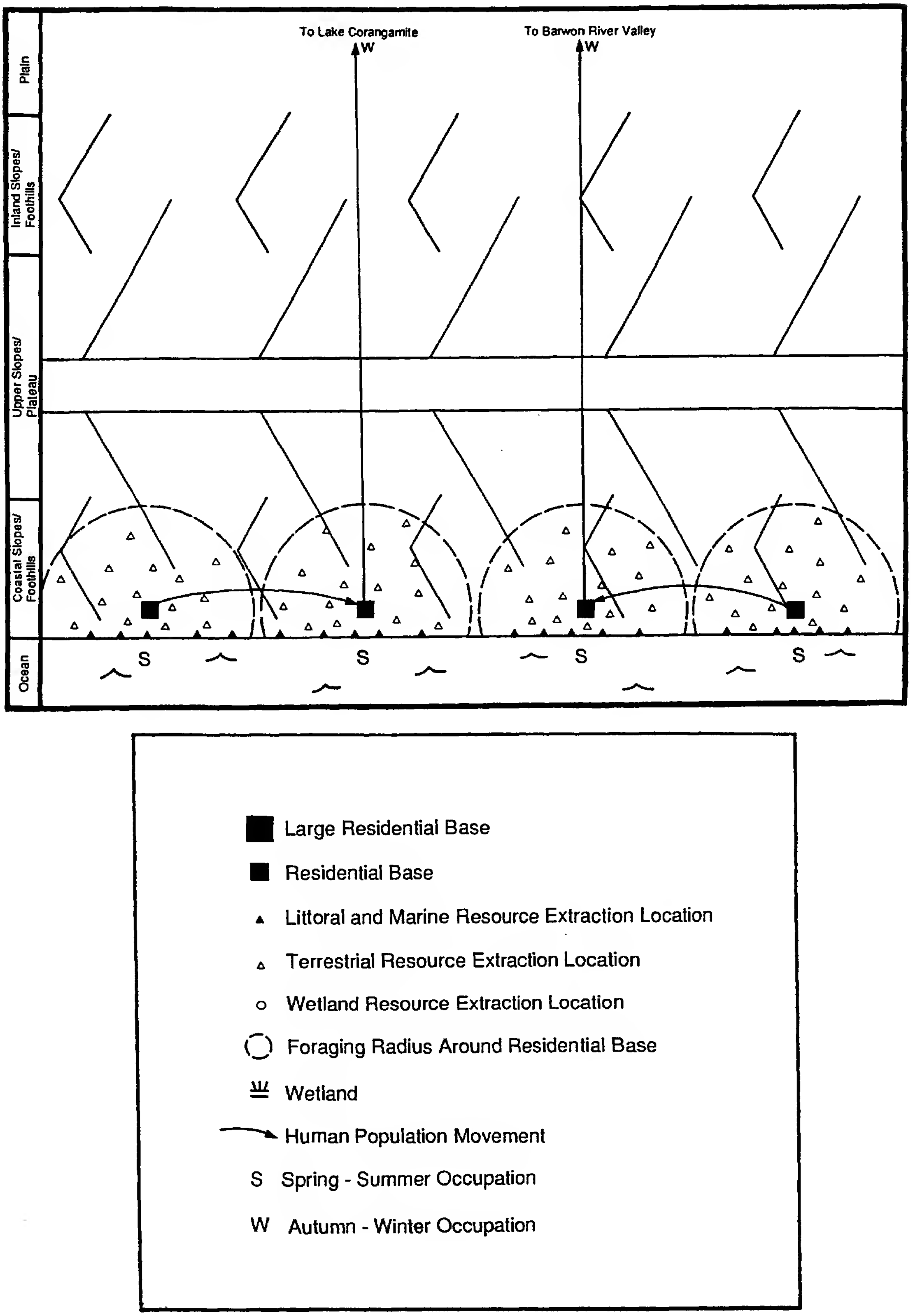
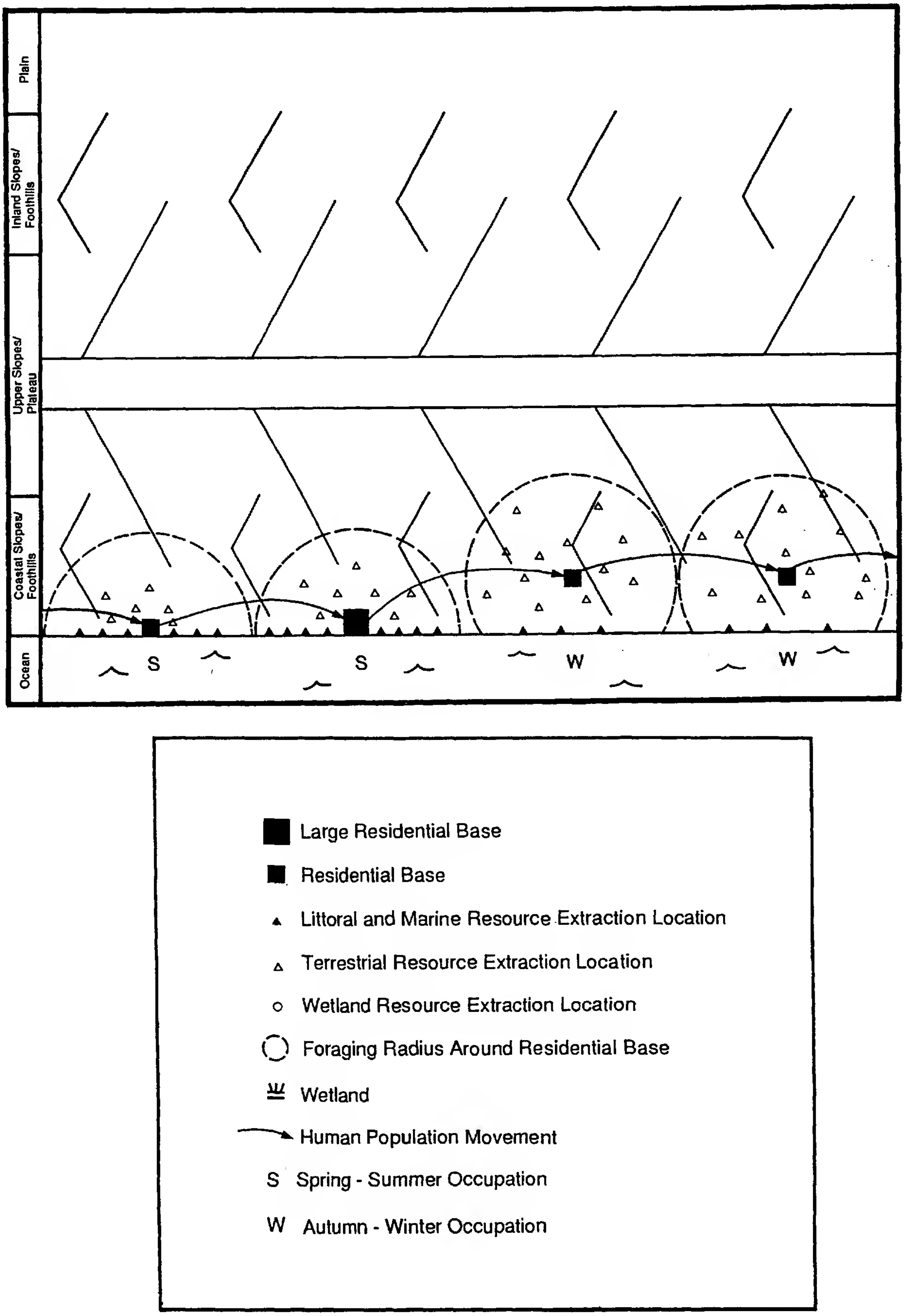


Figure 9. The Witter Post-Microblade Period Aboriginal Settlement Pattern Model (Witter n.d.).



The Post-Microblade period differed in that there was no seasonal exodus from the Otway Range (Witter n.d.). Instead, Aboriginal groups intensively exploited the coast and southern slopes, which were occupied year round (figure 9). Gathering plant foods replaced hunting land mammals as the most important dietary contribution. Aboriginal people followed an 'orbiting' settlement strategy in which small groups were dispersed in small camps most of the time. Several of these groups occasionally or periodically aggregated at major base camps when and where sufficient short-term abundance of food resources occurred. In summer and spring they intensively exploited coastal resources from small camps scattered along the shoreline. Winter and fall camps were located on the lower slopes of the south side of the Otway Range, where mammal and plant resources comprised the basic diet. Sporadic excursions to the coast for fishing or seal hunting were also thought to have occurred.

The Aboriginal Archaeological Database

Prior to the start of field work in February 1991, 218 archaeological sites on the VAS site register were recorded for the Otway study area (figure 12, appendix).[2] The following site types were represented: shell midden (84.4% of sites), artefact scatter (9.6%), isolated artefact (1.8%), rock shelter (1.4%), quarry (0.5%), burial (0.5%), mound (0.5%), grinding groove (0.5%) and fish trap (0.5%). In addition, private artefact collections and non-sites (deregistered sites) were also on record. Preservation condition had been recorded for 133 sites, with the following breakdown: excellent (1.8%), good (11.5%), fair (47.8%), poor (17.7%), very poor (20.4%), destroyed (0.9%). With almost 40% of archaeological sites in poor or worse condition, the overall state of sites in the study area was not encouraging, especially considering that many of these sites were recorded at least eight years prior to 1991.

A variety of land-altering activities have operated in the study area since the mid-19th century and the effects of many of these on archaeological sites have been disastrous, as is apparent in the condition of known sites discussed above. The agents of disturbance and their known and potential effects on archaeological sites are reviewed below, with an emphasis on ongoing land-disturbing activities.

Although there is a long history of logging in the study area, logging undertaken since the late 1960s has been particularly destructive to archaeological sites. This is largely because of the heavy duty machinery employed for clearfelling and the common use of mechanical ground disturbance as a method of seedbed preparation for reforestation (Brinkman and Farrell 1990:92). When the effects of logging on archaeological sites are considered, we should also be concerned with the tracks, landings and other disturbances associated with the actual area of tree felling. Artificially levelled landings, for example, will be heavily disturbed and sites on them will be destroyed.

Coupes must be considered as areas of heavy disturbance and we can expect sites on them to be moderately disturbed to destroyed. Certainly, features and spatial associations between items will be lost, although the durable stone items will undoubtedly remain, but not necessarily without damage.

Tree plantations are especially destructive because not only has the land usually been clearfelled with the aid of heavy-duty machinery, but it has often been contoured or prepared with machinery for planting. Repeated disturbance due to harvesting is expected. Plantations, therefore, have very little archaeological potential. Artefacts may be found, but these will probably be out of context. It is possible that in exceptional circumstances buried sites in plantations may have survived largely intact.

Agriculture since the mid-19th century has involved clearing most of the forests in the Otway Range. Fortunately, early clearing activities were not as destructive as those of the present in which bulldozers are employed. In cases of recent clearance, disturbance will be approximately as severe as in recent logging coupes.

The actual ploughing of land once it has been cleared does not destroy artefact scatter sites, although it will disturb them and damage some artefacts. Spatial patterning in artefact scatters will not be severely distorted (Lewarch and O'Brien 1981) and deeply buried sites (i.e. greater than about 40 cm below surface) will be left intact, providing they survive the initial clearing. Obviously, sites such as scarred trees, rock alignments and mounds will be destroyed or at least severely disturbed by clearing and ploughing.

The use of conveyor belt harvesting equipment for potato farming is also destructive as it moves all items in the ploughzone from their context and clusters them elsewhere. It also brings larger artefacts (especially ground stone items) to the attention of the potato sorters who often collect them. Potato farming is generally destructive of archaeological sites with its frequent ploughing and harvesting.

There are eight water supply catchments in the study area, under the control of six water boards (Brinkman and Farrell 1990:99–100). Activities associated with storing and transporting water supplies have undoubtedly destroyed archaeological sites. Dams such as that of the West Barwon Reservoir, constructed by the Geelong and District Water Board (Brinkman and Farrell 1990:99), have probably resulted in the flooding of sites and the exposure of others to water erosion with the periodic changes in water level. In addition, preparation of the dam site itself could have involved damage to sites, as would the collection of fill for the dam. Construction of canals, canalised channels, water pipelines and pumping stations can also disturb sites.

Quarrying sand, gravel, hard rock, and limestone occurs at 32 locations in the study area (Brinkman and Farrell 1990:map 8) and it is quite possible that some archaeological sites have been affected.

Besides the direct effects of human activities on archaeological sites, there are indirect effects caused by these activities. Sites in low-lying areas are probably being constantly buried by a general increase in sediment deposition throughout low-lying parts of the Otway study area. Simultaneously, soil erosion caused by agricultural land clearing, logging and fires is disturbing or destroying sites on higher ground. There is probably little that can be done to mitigate these effects, but a general degradation of the archaeological record should be noted.

Notes

1. Gould (1969) proposed the term 'Australian Small Tool Tradition' (ASTT) to describe the occurrence of microblade technology, backed blades and microlithic tools in Australian stone tool assemblages. The ASTT is uniformly late Holocene in age wherever it occurs in Australia, generally after ca. 5000–4000 BP, however, the specific dates for its initial occurrence and its eventual abandonment seem to vary from region to region (White and O'Connell 1982:123–125). There are strong indications that in the Otway region the ASTT may date between ca. 5000 and 2000 BP–1500 BP. Three sites excavated along the Otway Coast dating between ca. 1500–180 BP conspicuously lacked evidence of microlithic technology and other ASTT hallmarks (Mulvaney 1962; Fullagar 1982; Lourandos 1980, 1983; Zobel, Vanderwal and Frankel 1984), giving impetus to Witter's Microblade and Post-Microblade periods.

2. This figure differs from the 222 sites published by du Cros (1990:17) for the Otway Study Area, but the discrepancy can be readily explained. The study area boundaries differ between du Cros' report and the present one, resulting in four sites within her study area lying outside mine. Not quite so easily explained are the 239 sites listed in Appendix 3, the Site Gazetteer of du Cros' report. I think the general problem is that the 'Minark' computer printout has listed all sites for most 1:100,000 mapsheets present in du Cros' study area, although large portions of several mapsheets lie outside her study area. This has resulted in approximately 44 sites from outside the study area being included in the printout. Subtracting 44 from 239 leaves only 195 sites and points out another error. For some unknown reason, the 'Minark' printout leaves out the first 34 sites for 1:100,000 mapsheet 7520. Of these, 27 are within du Cros' study area, and if added to 195, equals 222, the figure du Cros uses in the body of her report.

3. The Otway Survey

The Otway Survey comprised two distinct field programs: the main one being a surface survey and the other a brief experimental subsurface survey pilot project involving shovel test sampling. These are discussed separately below.

Surface Survey

The aim of this project was to develop a predictive model of site distribution and density in the study area. Predictive models have only recently started to be applied to archaeological research in Victoria (e.g. du Cros 1988; Hall n.d.; Witter n.d.); therefore it is necessary to review the concept and its applications prior to discussing the research design, field methods and results.

Predictive Models

Archaeologists working in cultural heritage management contexts are frequently required to generalise about the distribution and density of archaeological sites in a region for heritage management purposes. Basically, they must analyse a small body of information on known site locations to identify patterns of site distribution across the landscape. The perceived patterns are then crystallised into generalisations of site distribution and density for various portions of the entire region, most of which is usually unknown archaeologically. This is the site distribution model which predicts how many sites will be found in specific areas if subjected to archaeological survey.

There are several ways archaeologists can develop predictive site distribution models. A regional model can be purely theoretical or hypothetical—that is, not based on empirical evidence from the target region. Instead, it may be based on a model developed for a nearby, similar region, or on general principles of hunter–gather settlement behaviour. These models would only be useful in the preliminary stages of regional field investigation or model construction. Models based on ethnographic and ethnohistoric data can be very useful for predicting archaeological site locations (e.g. Thomas 1972; Richards 1984; Richards et al. 1989), but typically only for sites dating to the most recent precontact periods. Unless such models are combined with other approaches and checked against site distribution data, they are of unknown reliability. Finally, a predictive model can be based on the distribution of known sites. Often, the site distribution data are combined with excavation and other relevant data sources to develop a model. As an operational condition of such a model, it is assumed that settlement behaviour is expressed differentially across the landscape, resulting in distinct distributions of archaeological site types in different areas. Sites can also be considered as a dependent variable for which correlated independent environmental variables are identified, thus allowing the presence of certain environmental variables to predict site location. The above approaches are often combined to develop a predictive model and, occasionally, a model developed using one approach will be tested with data from another (e.g. Millar 1984; Richards et al. 1989).

Most predictive models are based on at least limited site locational data. If the data consist of a statistically valid sample, then multivariate statistical techniques, especially discriminant function analysis and logistical regression, can be employed to develop the model (e.g. Custer et al. 1986; Kvamme 1985; Larralde and Chandler 1981; Parker 1985). If such a model is then tested against independent data (site locational information derived from additional field survey or non-site data from maps and airphotos), then a highly accurate model with strong predictive power is likely to result (e.g. Custer et al. 1986; Parker 1985).

Statistically valid samples, multivariate statistical analysis and field testing are the ideals in predictive modelling. In most cases, however, the archaeologist has small, non-random, and usually biased samples with which to work. Further, common problems include a lack of pertinent ethnographic or ethnohistoric data and very little may be known of the prehistory of the study area. Testing of a model must be considered a luxury in most cultural heritage management studies. In situations where sophisticated multivariate modelling is not possible, several lines of evidence should be used to develop a predictive model. Such models should be considered preliminary and tested by additional survey, preferably random, in the region.

Once correlations between site locations and environmental or other variables have been identified, hypothetical site distributions and density patterns may be developed. These may be mapped, often by hatching or shading zones of varying archaeological heritage probability (e.g. Custer et al. 1986:figure 2; Parker 1985:figure 8.4; Rogge and Lincoln 1987:figure 3). These are often referred to as 'archaeological resource potential' or 'archaeological sensitivity' maps.

The use of these maps by cultural heritage managers and land use planners is varied and generally depends on the quality of the database from which they are derived. How much reliance should be placed on them is debatable, although even the best ones should not be used to entirely write-off areas from further consideration when threatened by large-scale destruction (Ambler 1984; Brose 1984; Condie 1984; King 1984; Plog 1984).

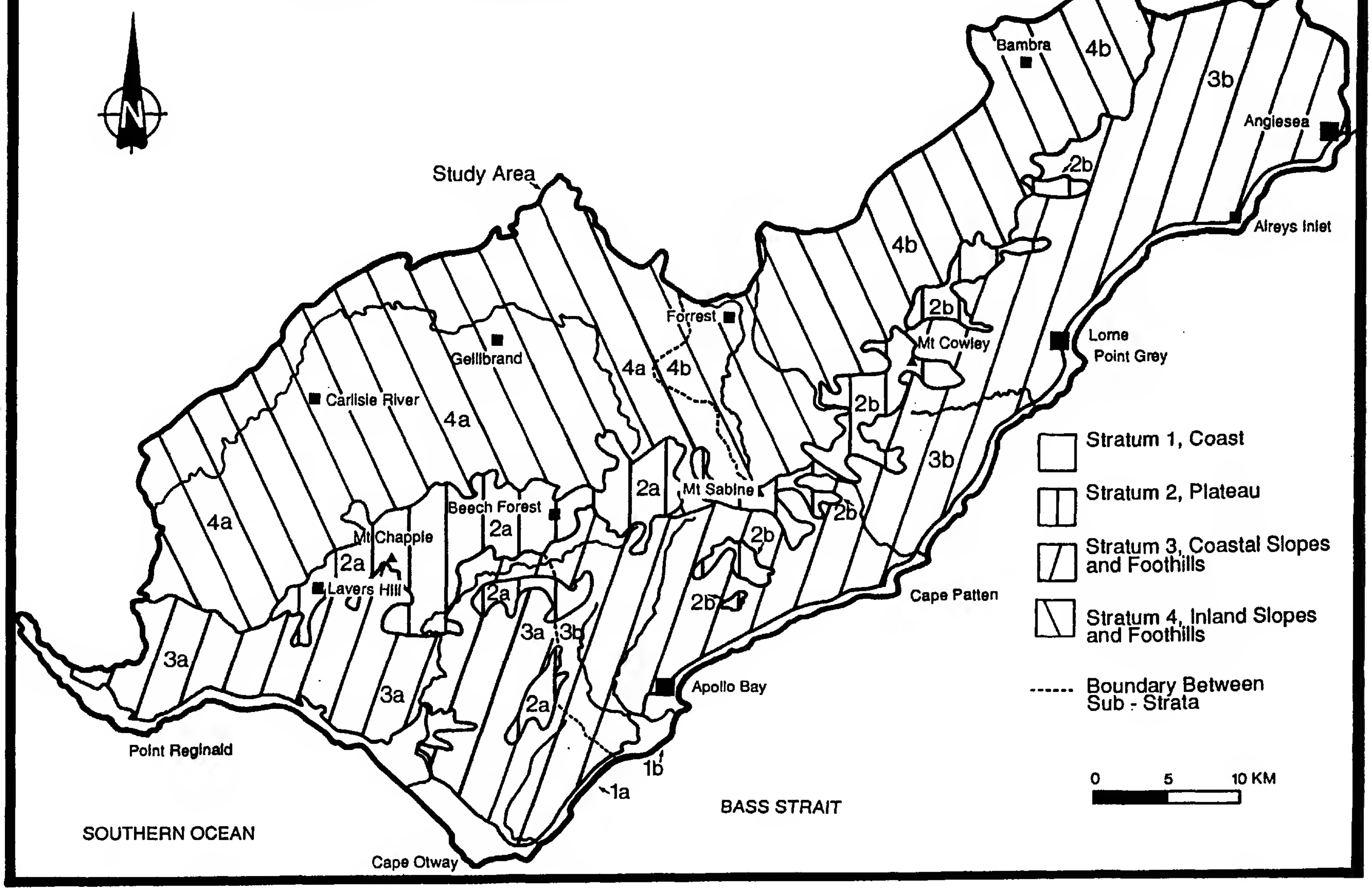
It is important to emphasise that *predictive models are no substitute for knowledge of actual site locations derived from field survey in a given area, rather, they indicate where sites are estimated to be located.* Sensitivity maps are most appropriately used as early planning tools that indicate the approximate site types and density expected in an area to alert managers of the need to relocate destructive projects to less archaeologically sensitive areas (Rogge and Lincoln 1987). If such relocation is not possible, the sensitivity maps can be used to estimate the number and types of sites to be affected and the approximate costs of appropriate archaeological impact assessment and mitigation.

Research Design

The field component of the Otway Survey was designed to collect data required for the development of a predictive model. It is clear from the above review of archaeological predictive modelling that it is desirable to have *representative* data for discussions of the distribution and density of archaeological sites in a region. It is also apparent from the predictive modelling review that a random sample provides statistically representative results; however, it was not possible to implement such an approach in the Otway Region. When it is considered that the study area is larger than 2000 km^2, is largely a heavily forested mountain range with poor road access, and the survey time available was five weeks with a crew of four persons, two obvious reasons become apparent. First, randomly selected survey blocks or transects would be very difficult to locate in the midst of heavy forest and many blocks would be very difficult and time consuming to get to. Second, sample units in forested areas have low ground surface visibility and therefore hold little possibility of site discovery. The above problems are not insoluble and such an approach could work on a larger scale project (more time, larger crew) that employed shovel test sampling as a basic field method (see section on subsurface surveying at end of this chapter).

The sampling approach employed in this study involved stratification of the Otway Range into four strata on the basis of environmental criteria which are presumed to have had significance in setting limits on possible precontact Aboriginal land use, given a hunter-gather economy (figure 10). For example, the coastal margin

Figure 10. Otway Survey Sampling Strata.



would have offered a more diverse range of natural resources than the dissected plateaus of the Otway Range. Thus, it is expected that the nature of precontact Aboriginal exploitation and occupation of these areas would have differed. It follows that differential Aboriginal land use would result in distinctive material residue, so that at present the types and frequencies of archaeological sites in these areas would be observably different.

Strata and sub-strata were used to demarcate areas of environmental distinctiveness so that effort could be directed to sampling this diversity. Within each sub-stratum are one or more landforms (or landform patterns), such as present floodplain, plain above flood level, gentle to moderate hill and steep mountain and hill (figure 3). Each of these landform patterns is comprised of several landform elements (Speight 1984). A hill, for example, usually consists of the landform elements crest, upper slope, mid-slope and lower slope. The landform element is the smallest unit recognised in this study and it is the basic sample unit employed. The ground surface of almost all of the Otway Range is obscured by forest litter, agricultural crops or pasture. Since subsurface probing was not possible as a routine survey method, it would have been meaningless to survey such areas. Therefore, only sample units with high surface visibility were considered for inspection. Unfortunately, areas in the Otway Range with high surface visibility are restricted to places where the surface has been recently disturbed (e.g. ploughed fields, forest tracks and logging coupes).

The sampling goal, then, was to examine high surface visibility examples of every landform element type on each landform pattern within each substratum. This approach is neither random nor systematic. It is not biased in the sense that certain landform elements were chosen over others because they were believed to have a higher potential for containing sites. Bias in the sample units examined is related to whatever biases operated in the selection of land for cultivation, logging or forest track location.

The majority of previously recorded archaeological sites in the study area are located along the coast (Stratum 1) which has been the focus of all earlier major archaeological surveys and excavations (chapter 2). Therefore, little additional surveying was carried out along the coast during this study so that our efforts could be applied to the virtually unknown slopes and plateaus of the Otway Range.

Field Methods

Five weeks of surface survey were undertaken between 4 February and 22 March 1991. Initially, three weeks were spent largely in the western and central portions of the study area. This was followed by one week at VAS in Melbourne during which the results were reviewed and sub-strata, landforms and landform elements requiring further investigation were identified. The final three weeks of field work (4–22 March) involved two weeks of surface survey (4–8, 18–22 March), mainly in the eastern and central portion of the study area, and one week of survey (12–15 March) employing shovel test sampling.

The field crew consisted of the project officer (the author), an archaeological assistant and two Aboriginal trainee archaeologists, one affiliated with the Framlingham Aboriginal Trust and the other with the Wathaurong Aboriginal Co-operative. For the week of the shovel test sampling, this crew was supplemented by three Aboriginal trainee site officers from VAS, their supervisor and a volunteer. The project officer supervised all aspects of the field work, with the archaeological assistant helping with the supervision of the Aboriginal trainee archaeologists. Typically, the crew was divided into two, with one trained archaeologist and a trainee in each team.

Each surveyed location, whether a transect (track), quadrat or an irregularly shaped area, comprised a 'survey block' (figure 11). Several environmental variables were recorded for each block on record forms, as were the locations of archaeological sites present. Most blocks contained several landform elements which were described separately. It is important to recognise that the 'sample units' discussed in this report consist of each of the individual landform elements present within the survey blocks and not the survey blocks. Thus, the 34 survey blocks examined contained 60 sample units (i.e. individual landform element areas).

Each survey block was completely and systematically examined for archaeological sites. Sites were recorded on VAS site forms and stone artefacts were described and sketched on lithic description forms designed for this project. All sites and blocks were plotted on 1:25,000 topographic maps. Photographs were taken of blocks, sites and artefacts. Artefacts were not collected.

Generally, the entire crew surveyed each block together, with various personnel assigned different tasks. The project officer kept field notes summarising the results of each day's work. The project officer and archaeological assistant were responsible for photography and completing all block record forms. The entire crew participated in site and artefact recording.

Survey methods varied depending on the type of block. On open fields, the crew members walked parallel lines 5–10 m apart, depending on surface visibility. Artefact finds were marked with red flagging and once the block was surveyed at least two crew members would return to each find location to search the area intensively for more artefacts and to record the site. At logging coupes with winrows of logs and debris, each crew member surveyed a corridor between winrows until the block was completely inspected. Again, finds were flagged and later recorded.

The surveying of forest tracks was usually done by two crew members who were dropped off at one end of a long track and picked up at the other end at a prearranged time. In some cases, leapfrog methods were employed on a single track with one vehicle and the crew divided into pairs. On long tracks with poor vehicle access, all sites were recorded when found. During the rare occurrences of heavy rain, large sites were flagged during the survey and recorded the next day.

While there were some differences in the intensity of survey coverage between fields, tracks and coupes, these were not large. The surveys on different types of blocks are therefore considered to have yielded comparable results.

For the purposes of this research, all that was necessary to define an archaeological site was one stone artefact. Two artefacts or artefact clusters more than 50 m apart were considered to be separate sites. An arbitrary area of 1 m^2 was assigned to single artefact sites, while all other sites were measured from the outermost artefacts visible in the scatter. All sites were recorded on VAS site or isolated find forms.

Surface Survey Results

Five weeks of surface survey by a crew of three to four persons resulted in the examination of 34 blocks containing 60 sample units with a combined area of 1,854,500 m^2 (figure 11, tables 1–3). This work resulted in the discovery of 57 artefact scatter sites (figure 12, table 4). In addition, two private artefact collections were recorded in the study area.

Figure 11. Otway Survey Field Survey Block Locations.

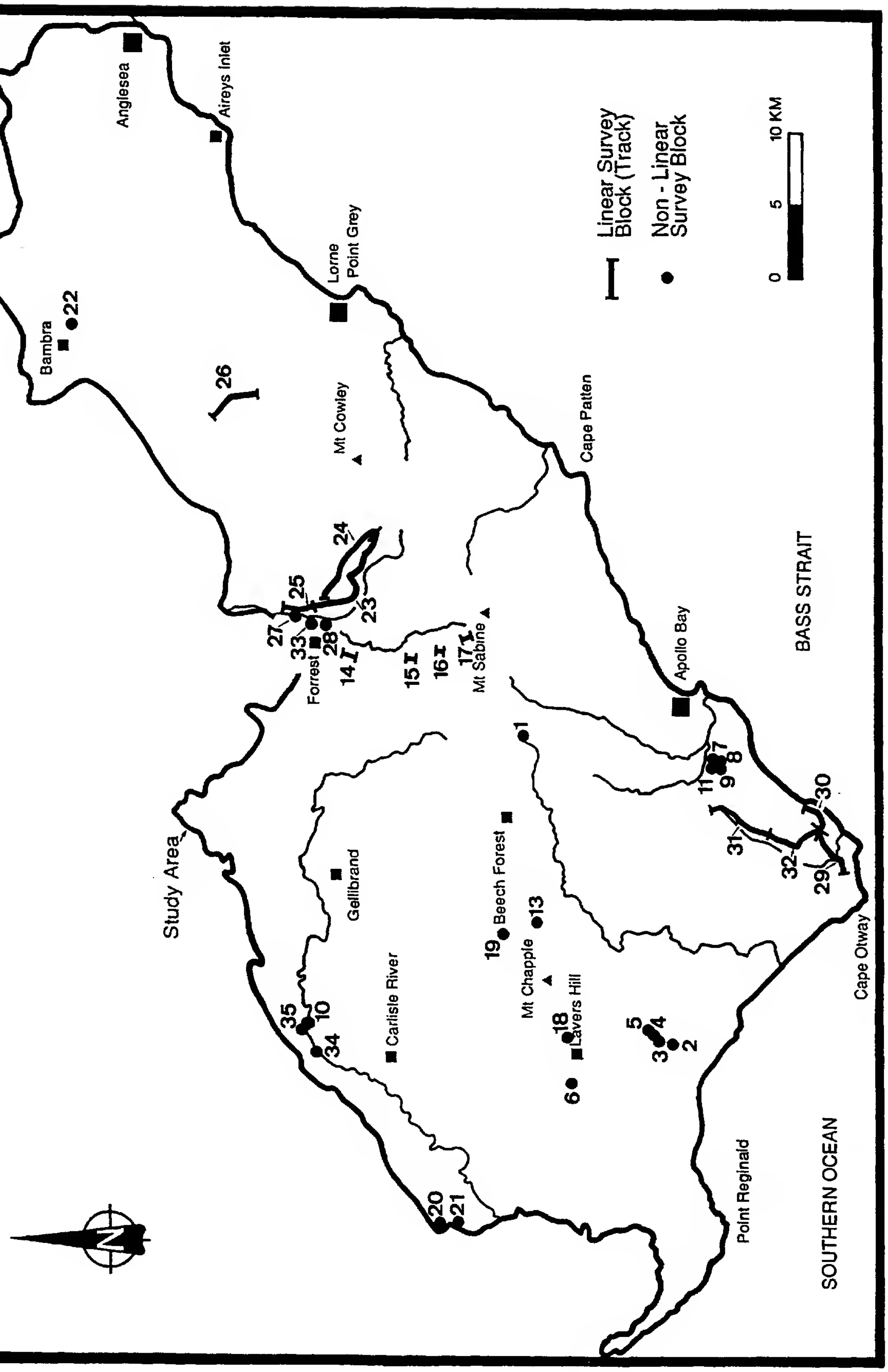


Table 1. Surveyed Sample Unit Distribution, Otway Study Area.

STRATUM	LANDFORM PATTERN	LANDFORM ELEMENT	SAMPLE UNIT
1a, Coast	Plain	Plain	-
		Crest	-
		Slope (Upper, Mid, Lower)	-
		Valley Flat	-
	Dune Plain	Plain	50
		Dune	-
		Swale	-
		Blow-Out	-
	Floodplain	Plain	21
	Plain and Gentle to Moderate Hill	Plain	-
		Crest	-
		Slope (Upper, Mid, Lower)	-
		Valley Flat	-
	Gentle to Moderate Hill	Plain	-
		Crest	-
		Slope (Upper, Mid, Lower)	54
		Valley Flat	-
	Steep Mountain and Hill	Crest	-
		Slope (Upper, Mid, Lower)	-
		Valley Flat	-
2a, Plateau	Gentle to Moderate Hill	Plain	-
		Crest	1
		Slope (Upper, Mid, Lower)	22,28,29
		Valley Flat	23
2b, Plateau	Gentle to Moderate Hill	Plain	-
		Crest	35,39,44
		Slope (Upper, Mid, Lower)	38,45
		Valley Flat	-
3a, Coastal Slopes	Steep Mountain and Hill	Crest	5,7,57,58
		Slope (Upper, Mid, Lower)	6,8,11,12
		Valley Flat	9,10
	Gentle to Moderate Hill	Crest	51,56
		Slope (Upper, Mid, Lower)	52,55
		Valley Flat	53
3a, Coastal Slopes	Floodplain	Plain	-
3b, Coastal Slopes	Steep Mountain and Hill	Crest	2,14,16,19
		Slope (Upper, Mid, Lower)	3,15,17,18,20

Table 1. Surveyed Sample Unit Distribution, Otway Study Area (cont.).

STRATUM	LANDFORM PATTERN	LANDFORM ELEMENT	SAMPLE UNIT
		Valley Flat	4
	Gentle to Moderate Hill	Plain	-
		Crest	-
		Slope (Upper, Mid, Lower)	-
		Valley Flat	-
	Floodplain	Plain	-
4a, Inland Slopes	Steep Mountain and Hill	Crest	25,26
		Slope (Upper, Mid, Lower)	13,27
		Valley Flat	-
	Gentle to Moderate Hill	Crest	-
		Slope (Upper, Mid, Lower)	-
		Valley Flat	-
	Plain	Plain	-
		Slope (Upper, Mid, Lower)	31,32
		River Terrace	62
	Floodplain	Plain	30,60,61
4b, Inland Slopes	Steep Mountain and Hill	Crest	24,36,41,46
		Slope (Upper, Mid, Lower)	37,40,47
		Valley Flat	42
	Gentle to Moderate Hill	Crest	43,48,49
		Slope (Upper, Mid, Lower)	33,59
		Valley Flat	34
	Plain	Plain	-
	Floodplain	Plain	-

Note: Sample units and their contents are described in table 3.

Table 2. Summary of Otway Survey Surface Survey Results by Stratum.

Stratum	Area Surveyed (m^2)	Number of Sites	Site Area (m^2)	Number of Surface Artefacts	SITEDENS	ARTDENS	SITEAREA%	ARCHDENS
1A	14,400	5	1,691	26	347.2	1805.6	11.74	7359.86
2A	272,200	4	4	4	14.7	14.7	.0015	.0003
2B	11,400	2	2	2	175.4	175.4	.0175	.54
2A+B	283,600	6	6	6	21.2	21.2	.0021	.001
3A	90,700	19	2,455	79	209.5	871.0	2.71	494.51
3B	726,500	13	12,580	168	17.9	231.3	1.73	7.16
3A+B	817,200	32	15,035	247	39.2	302.3	1.84	21.80
4A	536,300	5	5	5	9.3	9.3	.001	.0001
4B	198,800	9	5,032	108	45.3	543.3	2.53	62.27
4A+B	735,100	14	5,037	113	19.1	153.7	.69	2.03
Total Sample	1,850,300	57	21,769	392	30.8	211.7	1.18	7.69

Note: The archaeological density measures SITEDENS, ARTDENS, SITEAREA% and ARCHDENS are defined in chapter 4, page 46.

Ground surface visibility for most sample units was excellent, ranging from 70–100%. A few sample units with 40–50% visibility were also examined because they were the only examples of certain landform elements within a substratum.

Survey results are presented below by stratum (figure 10) and summarised in tables 1 and 2. Sample units surveyed are described in table 3.

Stratum 1, Coast

Stratum 1 is generally a 1 km wide strip from the high-water mark inland, except in three areas of extensive coastal plains (figure 10). It has a total area of 116.9 km^2.

Three sample units totalling 14,400 m^2 were surveyed in Stratum 1, all within Substratum 1a. Five sites containing a total of 26 artefacts were found and have a total area of 1691 m^2. Site density within these sample units is 347.2 sites/km^2, artefact density is 1805.6 artefacts/km^2 and sites occupy 11.74% of the surveyed area.

No concerted effort was made to survey Stratum 1 and the few sample units surveyed there reflect this fact. Sample units include one each within dune plain, floodplain and gentle to moderate hill landform patterns. Specific landform elements represented by the sample units are plains (two sample units) and mid to lower slope (one sample unit).

Stratum 2, Plateau

Stratum 2 corresponds exactly with Pitt's (1981: 64, 65, 108, 109) Beech Forest and Mount Sabine land systems. The plateau, consisting of gentle to moderate hills at the top of the Otway Range, has an area of 221.9 km^2. Total area surveyed is 283,600 m^2. All but one landform element type, the plain, is represented in the ten sample units surveyed; slopes are the most well-represented landform element, followed by crests and valley flats.

Six archaeological sites containing a total of six artefacts with a total area of 6 m^2 were found within Stratum 2. Site density is 21.2 sites/km^2 and artefact density is 21.2 artefacts/km^2. Sites occupy 0.00212% of the surveyed area.

Stratum 3, Coastal Slopes and Foothills

The coastal, or southern, slopes of the Otway Range comprise Stratum 3, which has an area of 862.4 km^2. Twenty-five sample units with a total area of 817,200 m^2 were surveyed within this stratum. Three landform patterns are present: steep mountain and hill, gentle to moderate hill, and floodplain. No sample units were located within the floodplain landform pattern due to a lack of exposed areas to survey. Landform elements crest, slope and valley flat are the only types present in the remaining two landform patterns, and each of these is represented by sample units.

Thirty-two archaeological sites were discovered in Stratum 3. These occupy an area of 15,035 m^2 and contain a total of 247 artefacts. Site density is 39.2 sites/km^2 and artefact density is 302.3 artefacts/km^2. Sites occupy 1.84% of the surveyed area.

Table 3. Sample Unit Descriptions for the Otway Survey and Previous Surveys in the Otway Study Area.

SU	P	BK	S	SS	SZ	LANDFORM	ELEMENT	SUAREA	DIST-URB	AGENT	GSV	FLORACOM	ELEV	WAT	WATERNAME	WAT DIST	ODIST	#S	TYPE	AAV SITE REGISTRATION NUMBER	SITE AREA	#ARTS
1	OT	1	2	A	3	GMH	CST	3200	HIGH	LOG	80	WS	550	C	BLACKWOOD	100	11.00	0	-	-	-	-
2	OT	1	3	B	3	SMH	CST,USL	210000	HIGH	LOG	80	WS	500	C	AIRE	100	10.50	5	AS,IF	7620/109-113	303	20
3	OT	1	3	B	3	SMH	MSL,LSL	189000	HIGH	LOG	80	WS	500	C	AIRE	50	10.50	0	-	-	-	-
4	OT	1	3	B	3	SMH	VFL	15000	HIGH	LOG	80	RS	450	C	AIRE	50	10.50	0	-	-	-	-
5	OT	2	3	A	1	SMH	CST,USL	5500	MOD	PLOW	90	WS	150	C	-	300	3.00	1	IF	7520/108	1	1
6	OT	2	3	A	1	SMH	MSL,LSL	1400	MOD	PLOW	90	WS	150	C	-	300	3.00	1	IF	7520/107	1	1
7	OT	3	3	A	1	SMH	CST,USL	200	MOD	PLOW	100	WS	150	C	-	100	5.00	0	-	-	-	-
8	OT	3	3	A	1	SMH	MSL,LSL	1600	MOD	PLOW	100	WS	150	C	-	50	5.00	0	-	-	-	-
9	OT	3	3	A	1	SMH	VFL	200	MOD	PLOW	100	RS	150	C	-	50	5.00	0	-	-	-	-
10	OT	4	3	A	1	SMH	VFL	800	MOD	PLOW	100	RS	150	C	-	50	5.00	0	-	-	-	-
11	OT	4	3	A	1	SMH	LSL,MSL,USL	3200	MOD	PLOW	100	WS	150	C	-	50	5.00	1	IF	7520/109	1	1
12	OT	5	3	A	1	SMH	USL,MSL	2200	MOD	PLOW	100	WS	150	C	-	100	5.00	1	IF	7520/110	1	1
13	OT	6	4	A	3	SMH	USL	108500	HIGH	LOG	80	WS	400	C	-	150	9.00	1	IF	7520/111	1	1
14	OT	7	3	B	1	SMH	CST	20000	MOD	PLOW	100	WS	200	C	-	50	3.00	1	AS	7620/114	4000	21
15	OT	7	3	B	1	SMH	USL,MSL	5000	MOD	PLOW	100	WS	150	C	-	50	3.00	0	-		-	-
16	OT	8	3	B	1	SMH	CST	37500	MOD	PLOW	100	WS	200	C	-	150	2.50	3	AS,IF	7620/115,117,118	1006	20
17	OT	8	3	B	1	SMH	USL	25000	MOD	PLOW	100	WS	150	C	-	100	2.50	1	AS	7620/116	20	3
18	OT	9	3	B	1	SMH	MSL,LSL	212500	MOD	PLOW	100	WS	200	C	-	100	3.00	2	AS,IF	7620/119,120	51	4
19	OT	11	3	B	1	SMH	CST	3100	MOD	PLOW	100	WS	200	C	-	200	3.00	1	AS	7620/121	3125	67
20	OT	11	3	B	1	SMH	USL	9400	MOD	PLOW	100	WS	200	C	-	150	3.00	1	AS	7620/121	4075	33
21	OT	12	1	A	1	PFL	FLP	1200	MOD	TRACK	100	CC	50	R	GELLIBRAND	50	1.00	0	-	-	-	-
22	OT	13	2	A	3	GMH	MSL,LSL	39200	HIGH	LOG	80	WS	450	C	YOUNG	100	15.50	1	IF	7520/112	1	1
23	OT	13	2	A	3	GMH	VFL	9800	HIGH	LOG	80	RS	400	C	YOUNG	50	15.50	0	-	-	-	-
24	OT	14	4	B	3	SMH	CST	16000	MOD	CLEAR	90	DS	300	C	-	150	19.00	0	-	-	-	-
25	OT	15	4	A	3	SMH	CST	2000	MOD	CLEAR	90	WS	450	C	-	300	15.00	0	-	-	-	-
26	OT	16	4	A	3	SMH	CST,USL	500	MOD	CLEAR	100	WS	450	C	-	150	13.00	1	IF	7620/122	1	1
27	OT	17	4	A	3	SMH	USL	4000	MOD	CLEAR	90	WS	450	C	-	150	11.00	0	-	-	-	-
28	OT	18	2	A	3	GMH	USL	70000	MOD	PLOW	100	WS	500	C	-	100	9.50	0	-	-	-	-
29	OT	19	2	A	3	GMH	USL	150000	MOD	PLOW	100	WS	500	C	-	150	17.00	3	IF	7520/113-115	3	3
30	OT	20	4	A	2	PFL	FLP	135000	MOD	PLOW	100	RD	50	R	KENNEDY'S	100	15.00	0	-	-	-	-
31	OT	20	4	A	2	PAF	LSL,MSL	15000	MOD	PLOW	100	FF	50	C	-	50	15.00	1	IF	7620/116	1	1
32	OT	21	4	A	3	PAF	LSL,MSL	120000	MOD	PLOW	100	FF	50	C	-	150	14.00	0	-	-	-	-
33	OT	22	4	B	3	GMH	LSL	79300	MOD	PLOW	90	FF	250	C	WORMBETE	100	13.50	0	-	-	-	-
34	OT	22	4	B	3	GMH	VFL	8800	MOD	PLOW	90	RD	250	C	WORMBETE	50	13.50	0	-	-	-	-
35	OT	23	2	B	3	GMH	CST	3900	MOD	TRACK	90	WS	550	C	-	250	11.50	2	IF	7620/123,124	2	2
36	OT	23	4	B	2	SMH,GMH	CST	23900	MOD	TRACK	90	DS,FF	300	C	BARWON E	250	16.00	7	AS,IF	7620/125-131	4991	105
37	OT	23	4	B	3	SMH	USL	4500	MOD	TRACK	90	DS	450	C	KING	200	13.00	0	-	-	-	-
38	OT	24	2	B	3	GMH	USL	1500	MOD	TRACK	70	WS	550	C	SEYMOUR	250	12.00	0	-	-	-	-
39	OT	24	2	B	3	GMH	CST	800	MOD	TRACK	70	WS	550	C	SEYMOUR	300	12.00	0	-	-	-	-
40	OT	24	4	B	3	SMH	USL,MSL,LSL	5900	MOD	TRACK	70	DS,FF	350	C	KING	200	15.50	0	-	-	-	-
41	OT	24	4	B	3	SMH	CST	14400	MOD	TRACK	70	DS,FF	350	C	KING	200	15.00	0	-	-	-	-
42	OT	24	4	B	3	SMH	VFL	300	MOD	TRACK	70	RD	200	C	KING	50	17.50	0	-	-	-	-
43	OT	25	4	B	2	GMH	CST	12400	MOD	TRACK	100	HW	250	R,S	BARWON E	350	19.50	2	AS,IF	7620/132,133	41	3
44	OT	26	2	B	3	GMH	CST	3700	MOD	TRACK	40	DS	500	C	-	250	9.00	0	-	-	-	-
45	OT	26	2	B	3	GMH	USL	1500	MOD	TRACK	40	DS	450	C	-	250	9.00	0	-	-	-	-

Table 3. Sample Unit Descriptions for the Otway Survey and Previous Surveys in the Otway Study Area (cont.).

SU	P	BK	S	SS	SZ	LANDFORM	ELEMENT	SUAREA	DIST-URB	AGENT	GSV	FLORACOM	ELEV	WAT	WATERNAME	WAT DIST	ODIST	#S	TYPE	AAV SITE REGISTRATION NUMBER	SITE AREA	#ARTS
46	OT	26	4	B	3	SMH	CST	6200	MOD	TRACK	40	DS	400	C	-	300	10.50	0	-	-	-	-
47	OT	26	4	B	3	SMH	USL	2100	MOD	TRACK	40	DS	400	C	-	300	10.50	0	-	-	-	-
48	OT	27	4	B	2	GMH	CST	2400	LOW	NATURE	5	HW	250	C,S	-	350	19.50	1	AS	7620/134	1	0
49	OT	28	4	B	3	GMH	CST	1800	LOW	NATURE	5	FF	250	R	BARWON W	250	19.00	1	AS	7620/135	50	0
50	OT	29	1	A	1	CSD	PLN	6000	MOD	TRACK	100	FF	100	R	PARKER	400	1.50	2	AS,IF	7620/136,137	1321	8
51	OT	29	3	A	1	GMH	CST	6800	MOD	TRACK	100	HW,WH	150	C	-	500	1.50	1	IF	7620/143	1	1
52	OT	29	3	A	1	GMH	USL,MSL,LSL	16600	MOD	TRACK	100	WH,FF	100	R,C	PARKER	250	1.50	3	AS,IF	7620/138,141,144	485	16
53	OT	29	3	A	1	GMH	VFL	2800	MOD	TRACK	100	RS	100	R,C	PARKER	50	1.50	0	-	-	-	-
54	OT	30	1	A	1	GMH	MSL,LSL	7200	MOD	TRACK	100	FF	50	C	-	200	0.50	3	AS	7620/139,140,142	370	18
55	OT	30	3	A	1	GMH	USL,MSL	8000	MOD	TRACK	100	WH	100	C	-	300	1.00	0	-	-	-	-
56	OT	30	3	A	1	GMH	CST	1600	MOD	TRACK	100	WH	150	C	-	100	1.50	0	-	-	-	-
57	OT	31	3	A	1	SMH	CST	15000	MOD	TRACK	90	WS,TR	250	R,C	PARKER	200	4.00	3	IF	7620/145-147	3	3
58	OT	32	3	A	1	SMH,GMH	CST	24800	MOD	PLOW	90	WS,DS,FF,WH	200	R,C	PARKER	200	3.00	8	AS	7620/148-155	1965	58
59	OT	33	4	B	2	GMH	USL,MSL,LSL	25000	MOD	PLOW	70	HW	200	R	BARWON E	250	19.50	0	-	-	-	-
60	OT	34	4	A	2	PFL	FLP	22500	MOD	PLOW	40	HW,RS	50	R	GELLIBRAND	100	26.50	1	IF	7520/118	1	1
61	OT	35	4	A	2	PFL	FLP	52500	MOD	PLOW	50	FF	50	R	GELLIBRAND	200	27.50	0	-	-	-	-
62	OT	36	4	A	2	PAF	RTR	76300	MOD	PLOW	80	FF	100	R	GELLIBRAND	200	27.50	1	IF	7520/119	1	1
63	AL	-	1	B	1	SMH	CLR	95000	-	-	-	-	50	C	STONY	150	0.50	2	SM	7620/69,71	962	2
64	AL	-	1	B	1	SMH	CHB	40000	-	-	-	-	50	C	SKENES	100	0.50	2	SM	7620/46,70	313	0
65	AL	-	1	B	1	SMH	CLR	55000	-	-	-	-	50	C	SKENES	500	0.50	2	SM	7620/67,72	13113	0
66	AL	-	1	B	1	SMH	CHB	25000	-	-	-	-	50	C	PETTICOAT	150	0.50	3	SM	7620/73,74,80	1813	0
67	AL	-	1	B	1	SMH	CHR	260000	-	-	-	-	50	C	SMYTHE	250	0.50	10	SM	7620/75-79,81-85	403	4
68	AL	-	1	B	1	SMH	CLR	70000	-	-	-	-	50	C	SUGARLOAF	250	0.50	4	SM	7620/44,86-88	3075	2
69	AL	-	1	B	1	SMH	CHR	15000	-	-	-	-	50	C	SUGARLOAF	200	0.50	1	SM	7620/41	5000	1
70	AL	-	1	B	1	SMH	CLR	47500	-	-	-	-	50	C	CARISBROOK	200	0.50	0	-	-	-	-
71	AL	-	1	B	1	SMH	CHR	25000	-	-	-	-	50	C	ORCHARD	200	0.50	0	-	-	-	-
72	AL	-	1	B	1	SMH	CLR	80000	-	-	-	-	50	C	GREY	200	0.50	4	SM	7620/11,89-91	332	0
73	AL	-	1	B	1	SMH	CHR	125000	-	-	-	-	50	R	KENNETT	500	0.50	3	SM	7620/94,96,97	18	0
74	AL	-	1	B	1	SMH	BS	27500	-	-	-	-	50	R	KENNETT	100	0.50	1	SM	7620/95	2400	1
75	AL	-	1	B	1	SMH	CHR	210000	-	-	-	-	50	C	MONASH	400	0.50	9	SM	7620/10,92,93,98,99,102,103,106	365	3
76	AL	-	1	B	1	SMH	BS	30000	-	-	-	-	50	R	WYE	250	0.50	1	SM	7620/100	6	0
77	AL	-	1	B	1	SMH	CHR	26250	-	-	-	-	50	R	WYE	300	0.50	0	-	-	-	-
78	AL	-	1	B	1	SMH	BS	20000	-	-	-	-	50	C	SEPARATION	100	0.50	1	SM	7620/107	2	0
79	AL	-	1	B	1	SMH	CHR	360000	-	-	-	-	50	C	JAMIESON	350	0.50	2	SM	7620/104,105	8	1
80	AL	-	1	B	1	SMH	BS	17500	-	-	-	-	50	R	CUMBERLAND	100	0.50	1	SM	7620/42	2500	0
81	AL	-	1	B	1	SMH	CHR	185000	-	-	-	-	50	C	SHEOAK	500	0.50	0	-	-	-	-
82	AL	-	1	B	1	SMH	BS	18750	-	-	-	-	50	R	ST.GEORGE	100	0.50	2	SM	7620/43,108	5450	2
83	AL	-	1	B	1	SMH	CHR	60000	-	-	-	-	50	R	ST.GEORGE	400	0.50	0	-	-	-	-
84	ABABC3		1	B	1	PAF,GMH	CLR	35000	-	-	10	-	50	R	BARHAM	300	0.50	1	SM	7620/33	22000	3
85	ABABC4		1	B	1	PAF,CSD	BB	90000	-	-	10	-	50	C	-	600	0.50	0	-	-	-	-
86	ABABC5		1	B	1	PAF,CSD	CHR	1600	-	-	50	-	50	C	-	1150	0.50	1	SM	7620/32	2000	3
87	ABABC6		1	B	1	PAF,GMH	CHR	52500	-	-	10	-	50	C	-	350	0.50	7	SM	7620/05-09,20,30,31	11216	6
88	ABMLS1		1	B	1	PAF,GMH	USL	2000	-	-	50	-	50	C	-	200	0.50	2	AS,IF	X2,X4	5	5
89	AB MLS2		1	B	1	PAF,GMH	USL	450	-	-	50	-	50	C	-	50	1.00	0	-	-	-	-
90	AB MLS3		1	B	1	PAF,GMH	PLN	300	-	-	80	-	50	C	-	50	1.00	0	-	-	-	-

Table 3. Sample Unit Descriptions for the Otway Survey and Previous Surveys in the Otway Study Area (cont.).

SU	P	BK	S	SS	SZ	LANDFORM	ELEMENT	SUAREA	DIST-URB	AGENT	GSV	FLORACOM	ELEV	WAT	WATERNAME	WAT DIST	ODIST	#S	TYPE	AAV SITE REGISTRATION NUMBER	SITE AREA	#ARTS
91	ABMLS4		1	B	1	PAF,GMH	PLN	400	-	-	50	-	50	C	-	250	0.50	1	AS	X1	7	7
92	ABMLS5		1	B	1	PAF,GMH	FLP	400	-	-	50	-	50	C	-	600	0.50	1	AS	X3	9	9
93	ABMLS6		1	B	1	PAF,GMH	DNE	20	-	-	100	-	50	C	-	750	0.50	1	SM	7520/104	2	1
94	ABMAB15		1	B	1	PAF,GMH	PLN	3200	-	-	50	-	50	C	-	250	1.50	1	AS	7620/40	13500	41
95	ABMAB16		1	B	1	PAF,GMH	PLN	1800	-	-	30	-	50	C	-	300	1.00	1	AS	7520/103	10800	59
96	AB	ABA	1	B	1	PAF,GMH	USL	1000	-	-	80	-	50	C	-	150	1.00	1	AS	7620/35	90	11
97	AB	ABB	1	B	1	PAF,GMH	CST	4000	-	-	80	-	100	C	-	500	1.00	2	AS,IP	22,X1	3001	13
98	AB	ABC	3	B	1	SMH	CST	1200	-	-	10	-	200	C	-	250	1.50	1	AS	X1	3	3
99	AB	ABD	3	B	1	SMH	CST	275	-	-	20	-	150	C	-	150	1.50	2	AS	X1,X2	12	12
100	AB	ABE	3	B	1	SMH	CST	4000	-	-	20	-	100	C	-	100	1.50	1	AS	7620/36	3125	175
101	AB	ABF	3	B	1	SMH	CST	25000	-	-	10	-	100	C	-	100	1.50	2	AS,LQ	31,32	4360	237
102	AB	ABG	1	B	1	PAF,CSD	DNE	100	-	-	20	-	50	C	-	350	0.50	1	SM	X1	2	2
103	AB	ABH	1	B	1	PAF,GMH	CST	4000	-	-	90	-	100	C	-	200	1.00	1	AS	X1	4	4
104	AB	ABI	1	B	1	PAF,GMH	USL	5000	-	-	90	-	100	C	-	250	0.50	0	-	-	-	-
105	AB	ABJ	3	B	1	SMH	CST,USL	26250	-	-	90	-	100	R	BARHAM W	100	3.00	3	AS	X1,X2,X3	14	14
106	AB	ABK	3	B	1	SMH	FLP	3500	-	-	90	-	50	R	BARHAM W	50	3.50	0	-	-	-	-
107	AB	ABL	1	B	1	PFL	FLP	220	-	-	20	-	50	R	BARHAM	50	1.00	0	-	-	-	-
108	AB	ABM	1	B	1	PFL	FLP	140	-	-	20	-	50	R	BARHAM	50	0.50	0	-	-	-	-
109	AB	ABN	1	B	1	SMH	MSL	22500	-	-	90	-	100	C	STONY	50	0.50	1	AS	7620/02	6	22
110	AB	ABO	3	B	1	SMH	FLP	8000	-	-	80	-	100	R	BARHAM E	50	4.50	0	-	-	-	-
111	AB	ORB	2	B	1	GMH	CST	40000	-	-	80	-	500	C	-	300	5.00	1	AS	X1	18	600
112	AB	ORC	2	B	3	GMH	USL	30000	-	-	80	-	500	C	-	100	5.50	1	AS	7620/03	1400	84
113	AB	ORF	3	A	1	GMH	FLP	1000	-	-	50	-	50	R	PARKER	50	1.50	0	-	-	-	-
114	AB	ORG	1	A	1	PAF,CSD	DNE	250	-	-	50	-	150	R	PARKER	800	2.50	1	AS	7620/12	125	23
115	AB	ORH	1	A	1	PAF,CSD	DNE	2500	-	-	50	-	150	C	-	800	2.50	0	-	-	-	-
116	AB	ORI	1	A	1	PAF,CSD	DNE	200	-	-	50	-	150	C	-	800	2.50	0	-	-	-	-
117	AB	ORK	1	B	1	SMH	LSL	2950	-	-	50	-	50	R	GREY	300	0.50	2	AS	7620/04,X1	79	59
118	AB	ORL	3	B	1	SMH	CST	600	-	-	20	-	200	C	-	250	0.50	2	AS,IP	X1,X2	10	10
119	AB	ORM	3	B	1	SMH	CST	1000	-	-	50	-	150	C	STONY	250	1.00	1	AS	X1	5	5
120	AB	ORN	2	B	3	GMH	CST,USL	1000	-	-	20	-	450	C	-	300	8.00	0	-	-	-	-
121	AV	-	1	A	1	PAF,CSD	USL	612500	-	-	25	-	100	R	AIRE	250	1.00	5	SM	7520/33,47,48,53,61	1250	9
122	AV	-	1	A	1	PAF,CSD	CHB	425000	-	-	65	-	50	R	AIRE	1000	0.50	45	SM,1F,RS	7520/34,35,37,38,45,46,49-51, 60,62-66,72-74,76-102	6444	37
123	AV	-	1	A	1	PAF,CSD	BB	113750	-	-	65	-	50	R	AIRE	300	0.50	0	-	-	-	-
124	AV	-	1	A	1	PAF,CSD	CST	325000	-	-	65	-	100	R	AIRE	850	1.50	2	AS	7520/42,43	340	5
125	AV	-	1	A	1	PAF,CSD	USL	300000	-	-	65	-	100	R	AIRE	800	1.50	1	AS	7520/39	480	3
126	AV	-	1	A	1	PAF,CSD	MSL	750000	-	-	65	-	100	R	AIRE	700	2.00	2	SM,RS	7520/24,40,41	19600	9
127	AV	-	1	A	1	PAF,CSD	LSL	500000	-	-	65	-	50	R	AIRE	350	1.50	4	SM	7520/25-27,44	100	10
128	AV	-	1	A	1	PFL	FLP	337500	-	-	65	-	50	R	AIRE	150	1.50	1	SM	7520/26	20000	1
129	AV	-	1	A	1	PAF,CSD,PFL	SCA	750000	-	-	25	-	50	R	AIRE	200	1.00	7	SM,RS,HB	7520/03,55-59,67,75	52221	5
130	AV	-	1	A	1	PAF,CSD	PLN	375000	-	-	65	-	100	R	AIRE	1000	1.00	0	-	-	-	-
131	AV	-	3	A	1	PFL	PLP	525000	-	-	25	-	50	L	L. CRAVEN	150	3.00	2	AS	7520/69,70	50	6

Key to Table 3

SU — Sample Unit identification number

P — Survey Project Identification: OT, Otway survey; AL, Apollo Bay to Lorne survey (LTU n.d.); AB, Apollo Bay survey (Witter n.d.); AV, Aire Valley survey (Stuart 1979)

BK — Survey Block Identification Number: Otway survey areas numbered sequentially in field (chapter 3; figure 11); Apollo Bay survey coding after Witter (n.d.)

S — Sampling Stratum: Stratum 1, Coast; Stratum 2, Plateau; Stratum 3, Coastal Slopes and Foothills; Stratum 4, Inland Slopes and Foothills (chapter 3; figure 10)

SS — Sampling Substratum (chapter 3; figure 10)

SZ — Archaeological Sensitivity Zone: Zone 1, Southern Periphery of the Otway Range; Zone 2, Northern Periphery of the Otway Range; Zone 3, Interior of the Otway Range (chapter 4; figure 25)

LANDFORM — Landform Pattern: GMH, Gentle to Moderate Hill; SMH, Steep Mountain and Hill; PAF, Plain Above Flood Level; PFL, Present Floodplain; CSD, Coastal Dune Plain (chapters 2, 3; figure 2)

ELEMENT — Landform Element: CST, Crest; USL, Upper Slope; MSL, Mid-Slope; LSL, Lower Slope; VFL, Valley Flat; FLP, Floodplain; PLN, Plain; RTR, River Terrace (chapter 3)

SUAREA — Sample Unit Area in Square Metres

DISTURB — Degree of Ground Disturbance: LOW, slight natural disturbance only; MOD, moderate disturbance caused by ploughing, land.clearing or forest track construction; HIGH, severe disturbance caused by logging

AGENT — Agent of Ground Disturbance: LOG, logging; PLOUGH, cultivation and ploughing; CLEAR, land clearing; TRACK, unsurfaced forest track; NATURE, natural disturbance only (chapters 2, 3)

GSV — Percent Ground Surface Visibility (chapter 3)

FLORACOM — Floristic Community: TR, Cool Temperate Rainforest; WS, Wet Sclerophyll Forest; DS, Damp Sclerophyll Forest; FF, Foothill Forest; RD, Riparian Damp Sclerophyll Forest; HW, Heathy Woodland; WH, Wet Heath; RS, Riparian Scrub; CC, Coastal Complex; (Brinkman and Farrell 1990:25-33; chapter 2)

ELEV — Mean Elevation (m): elevations derived from 1:25,000 topographic maps and expressed in 50m intervals

WAT — Type of Nearest Water Source: C, Creek; R, River; S, Spring

WATERNAME — Name of Nearest Water Source: from 1:25,000 topographic maps

WAT DIST — Distance to Nearest Water Source: straight-line distance on a 1:25,000 topographic map rounded off to the nearest 50 m interval (chapter 4)

ODIST — Distance to the Ocean: straight-line distance on a 1:25,000 topographic map rounded off to the nearest .50 km interval (chapter 4)

#S — Number of Archaeological Sites Present

TYPE — Types of Archaeological Sites Present: IF, Isolated Find; AS, Artefact Scatter (chapter 3)

AAV SITE REGISTRATION NUMBER — The four digits to the left of the slash refer to a 1:100,000 map sheet and the numbers to the right are the site identification numbers (figure 12)

SITE AREA — Total Area of all Sites in Square Metres

#ARTS — Total Number of Artefacts on Surface of all Sites: artefacts found in the shovel test pits within Sample Units 48 and 49 are not included in this category

Stratum 4, Inland Slopes and Foothills

Stratum 4 comprises the inland, or northern, slopes and foothills of the Otway Range and has an area of 928.1 km^2. Twenty-four sample units with a total area of 739,300 m^2 were surveyed. Four landform patterns—steep mountain and hill, gentle to moderate hill, plain, and floodplain—are present. Only one target landform element type within one landform pattern could not be sampled due to the unavailability of a suitable example with high surface exposure.

Sixteen sites were discovered, containing a total of 119 artefacts within a combined site area of 5088 m^2. Site density is 21.6 sites/km^2 and artefact density is 161.1 artefacts/km^2. Sites occupied 0.69% of the area surveyed within Stratum 4.

Aboriginal Archaeological Sites

Archaeological sites discovered during the Otway Survey are described in detail in table 4 and their locations plotted on figure 12. Their general characteristics are discussed below. All 57 archaeological sites discovered in the study area are stone artefact scatters. Thirty sites consist of single stone artefacts and 27 sites contain two or more stone artefacts. Site sizes range from 1 to 7200 m^2, with only six sites (10.5%) having areas of 1000 m^2 or greater.

All sites discovered were disturbed to some extent, but this was inevitable because the sampling strategy focused on disturbed areas with good surface visibility. The majority of sites (50 or 87.7%) are moderately disturbed, being located on ploughed fields, forest tracks or cleared areas. Highly disturbed sites (7 or 12.3%) are located on logging coupes.

Flaked stone artefacts, ground stone artefacts and clay heat retainers (hearth debris) were found at the sites. All sites had flaked stone artefacts present, while only one site (7620/121) had all three types of artefacts. Two sites (7620/114, 117) were comprised of flaked stone and heat retainers and one (7620/119) of flaked stone and ground stone. Clay heat retainers, evidence of the presence of hearths, were relatively rare at site 7620/117, common at 7620/121, and abundant at site 7620/114. A sandstone mortar fragment was found at site 7620/121 and a grinding stone (pestle) made of an unidentified dark, igneous rock was found at site 7620/119. It is worth noting that the sites with heat retainers and ground stone artefacts are all from one area approximately 750 m in diameter in the Barham River valley. Moreover, only one of these sites has an area of less than 1000 m^2.

The quantity of flaked stone artefacts present at sites ranged from one to 100, with only eight sites (14.0%) having ten or more. Simple retouched flakes comprised the majority of tools found, followed by scrapers and microliths. Debitage (or waste) included flakes, flake shatter, freehand percussion cores, bipolar cores and bipolar flakes. Flaked stone raw materials consisted of silcrete (62.1%), quartz (16.0%), flint (10.0%), quartzite (7.2%), chert (4.1%), chalcedony (0.3%) and unidentified (0.3%).

It is suspected that quartz probably makes up a higher proportion of artefacts than was observed. This material occurs naturally as rounded pebbles and small cobbles ubiquitously throughout much of the Otway Range. The quality is generally moderate to high and much of it is suitable for manufacturing flaked stone tools. There is no question that it was used for this purpose in precontact times. However, as almost all the sites found correspond with areas that have been disturbed by power machinery, there is the strong possibility that machine-induced

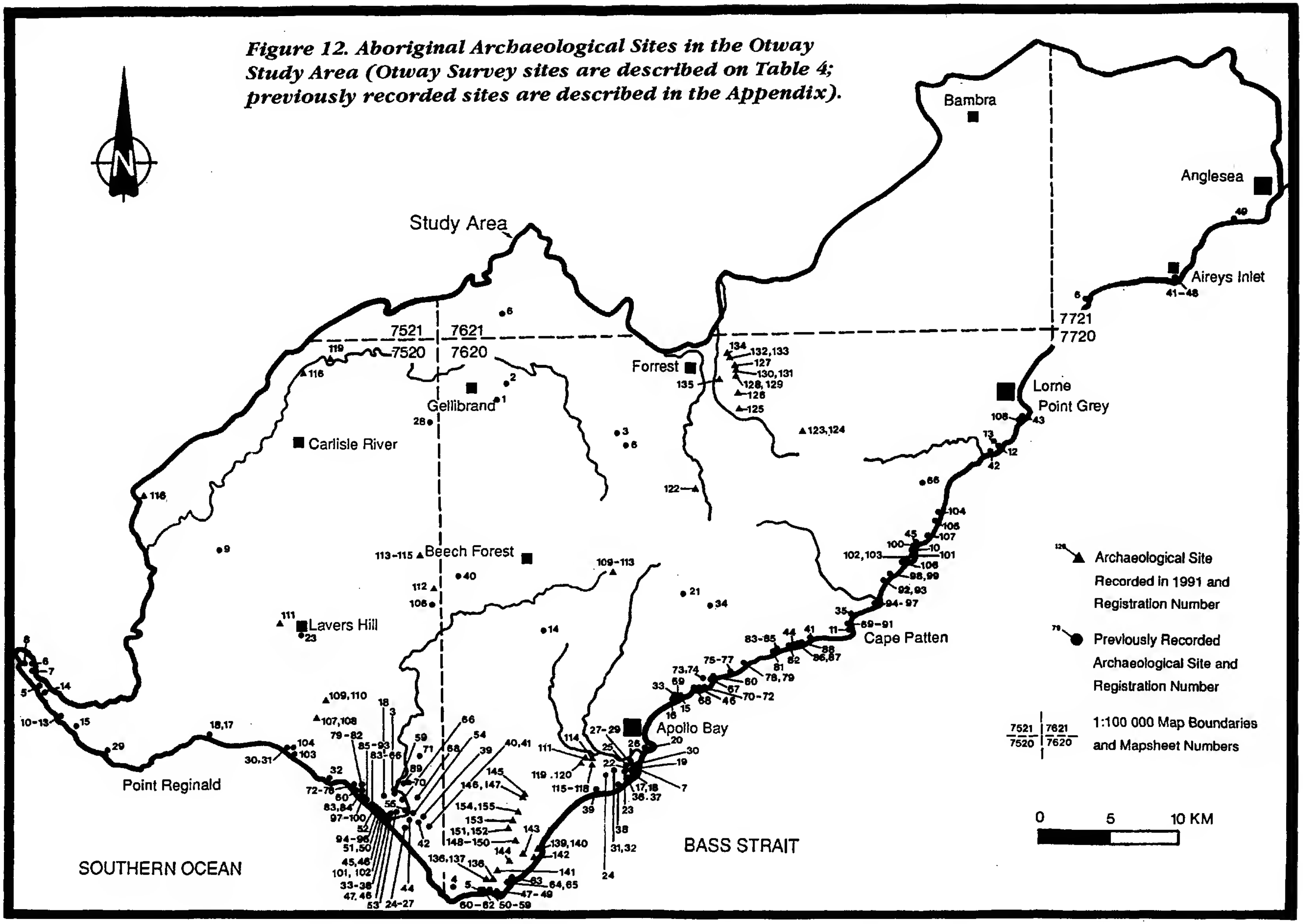


Figure 12. Aboriginal Archaeological Sites in the Otway Study Area (Otway Survey sites are described on Table 4; previously recorded sites are described in the Appendix).

Table 4. Aboriginal Archeological Site Descriptions for Sites Found During the Otway Survey.

MAP	SITE #	S	SS	BK	SU	SITE TYPE	SITE AREA	WAT	ART	QZ	QT	FT	SC	CH	CY	OR	CO	FL	BC	BF	SH	HR	GR
7520	107	3	A	2	6	IF	1	–	1	0	0	0	1	0	0	0	0	0	0	0	1	–	0
7520	108	3	A	2	5	IF	1	–	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7520	109	3	A	4	11	IF	1	–	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7520	110	3	A	5	12	IF	1	–	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7520	111	4	A	6	13	IF	1	–	1	0	0	0	0	0	1	0	0	0	0	1	0	–	0
7520	112	2	A	13	22	IF	1	–	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7520	113	2	A	19	29	IF	1	–	1	0	0	0	1	0	0	0	0	0	0	0	0	–	0
7520	114	2	A	19	29	IF	1	CRK	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7520	115	2	A	19	29	IF	1	CRK	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7520	116	4	A	20	31	IF	1	CRK	1	0	0	0	1	0	0	0	0	0	0	0	1	–	0
7520	118	4	A	34	60	IF	1	RIV	1	0	0	0	0	1	0	0	0	1	0	0	0	–	0
7520	119	4	A	36	62	IF	1	RIV	1	0	0	0	0	1	0	0	0	1	0	0	0	–	0
7620	109	3	B	36	2	AS	100	CRK	8	4	0	0	4	0	0	0	0	3	0	0	4	–	0
7620	110	3	B	36	2	AS	9	CRK	2	0	0	0	2	0	0	0	0	1	0	0	1	–	0
7620	111	3	B	36	2	AS	192	CRK	8	1	1	0	6	0	0	0	0	3	0	0	5	–	0
7620	112	3	B	36	2	IF	1	CRK	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7620	113	3	B	36	2	IF	1	CRK	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7620	114	3	B	7	14	AS	4000	RIV	21	2	2	1	15	0	0	1	1	9	0	0	9	+	1
7620	115	3	B	8	16	IF	1	RIV	1	0	0	0	1	0	0	0	1	0	0	0	0	–	0
7620	116	3	B	8	17	AS	20	RIV	3	0	0	1	2	0	0	0	1	1	0	0	1	–	0
7620	117	3	B	8	16	AS	1000	RIV	17	1	0	4	12	0	0	0	0	7	0	0	10	+	0
7620	118	3	B	8	16	AS	5	RIV	2	0	0	1	1	0	0	0	1	0	0	0	1	–	0
7620	119	3	B	9	18	AS	50	CRK	3	0	0	1	1	0	0	0	0	2	0	0	0	–	1
7620	120	3	B	9	18	IF	1	CRK	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7620	121	3	B	11	19	AS	7200	–	100	1	1	5	13	2	0	0	1	11	0	0	10	+	1
7620	122	4	A	16	26	IF	1	–	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7620	123	2	B	23	35	IF	1	RIV	1	0	1	0	0	0	0	0	0	1	0	0	0	–	0
7620	124	2	B	23	35	IF	1	RIV	1	0	0	0	1	0	0	0	0	0	0	0	1	–	0
7620	125	4	B	23	36	IF	1	RIV	1	0	0	0	1	0	0	0	0	0	0	0	1	–	0
7620	126	4	B	23	36	IF	1	RIV	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7620	127	4	B	23	36	AS	3744	RIV	75	3	10	3	53	6	0	0	3	33	0	0	39	–	0
7620	128	4	B	23	36	AS	63	RIV	6	1	1	0	4	0	0	0	0	4	0	0	2	–	0
7620	129	4	B	23	36	IF	1	RIV	1	0	0	0	0	1	0	0	0	0	0	0	1	–	0
7620	130	4	B	23	36	AS	5	RIV	2	0	0	0	2	0	0	0	0	1	0	0	1	–	0
7620	131	4	B	23	36	AS	1176	RIV	19	1	3	2	13	0	0	0	2	11	0	0	6	–	0

Table 4. Aboriginal Archeological Site Descriptions for Sites Found During the Otway Survey (cont.).

MAP	SITE #	S	SS	BK	SU	SITE TYPE	SITE AREA	WAT	ART	QZ	QT	FT	SC	CH	CY	OR	CO	FL	BC	BF	SH	HR	GR
7620	132	4	B	25	43	IF	1	RIV	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7620	133	4	B	25	43	AS	40	RIV	2	0	0	0	2	0	0	0	0	2	0	0	0	–	0
7620	134	4	B	27	48	AS	1	RIV	2	1	0	0	1	0	0	0	0	1	0	0	1	–	0
7620	135	4	B	28	49	AS	50	RIV	4	4	0	0	0	0	0	0	0	1	1	0	2	–	0
7620	136	1	A	29	50	AS	1320	RIV	7	1	0	2	4	0	0	0	2	2	0	0	2	–	0
7620	137	1	A	29	50	IF	1	RIV	1	0	0	1	0	0	0	0	1	0	0	0	0	–	0
7620	138	3	A	29	52	AS	480	RIV	11	4	1	0	6	0	0	0	1	6	0	0	4	–	0
7620	139	1	A	30	54	AS	90	CRK	5	0	1	2	2	0	0	0	0	3	0	0	2	–	0
7620	140	1	A	30	54	AS	48	CRK	5	0	0	0	5	0	0	0	0	1	2	1	1	–	0
7620	141	3	A	29	52	IF	1	RIV	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7620	142	1	A	30	54	AS	232	CRK	8	1	0	4	3	0	0	0	0	2	0	0	6	–	0
7620	143	3	A	29	51	IF	1	–	1	0	0	1	0	0	0	0	1	0	0	0	0	–	0
7620	144	3	A	29	52	IF	1	CRK	1	0	0	1	0	0	0	0	0	1	0	0	0	–	0
7620	145	3	A	31	57	IF	1	RIV	1	0	0	1	0	0	0	0	0	1	0	0	0	–	0
7620	146	3	A	31	57	IF	1	RIV	1	0	0	0	1	0	0	0	1	0	0	0	0	–	0
7620	147	3	A	31	57	IF	1	RIV	1	0	0	0	1	0	0	0	0	1	0	0	0	–	0
7620	148	3	A	32	58	AS	700	–	17	7	1	0	9	0	0	0	3	6	1	0	7	–	0
7620	149	3	A	32	58	AS	155	–	5	1	0	1	2	1	0	0	0	1	1	0	3	–	0
7620	150	3	A	32	58	AS	460	–	10	4	0	1	4	1	0	0	0	3	0	0	7	–	0
7620	151	3	A	32	58	AS	125	RIV	4	2	1	0	1	0	0	0	0	3	0	0	1	–	0
7620	152	3	A	32	58	AS	75	RIV	5	4	0	0	1	0	0	0	0	2	0	0	3	–	0
7620	153	3	A	32	58	AS	100	RIV	6	3	0	0	3	0	0	0	0	1	0	0	5	–	0
7620	154	4	B	32	58	AS	150	RIV	5	3	0	0	2	0	0	0	0	3	0	0	2	–	0
7620	155	4	A	32	58	AS	200	RIV	6	2	0	0	4	0	0	0	0	3	0	0	3	–	0

Key to Table 4

MAP — 1:100,000 Map Sheet

SITE# — AAV Site Registation Number

S — Sampling Stratum: Stratum 1, Coast; Stratum 2, Plateau; Stratum 3, Coastal Slopes and Foothills; Stratum 4, Inland Slopes and Foothills (chapter 3; figure 10)

SS — Sampling Substratum (chapter 3; figure 10)

BK — Survey Block Identification Number: survey areas numbered sequentially in field (chapter 3; figure 11)

SU — Sample Unit Identification Number (chapter 3; table 3)

SITE TYPE — Type of Archaeological Site; IF, Isolated Find; AS, Artefact Scatter (chapter 3)

SITE AREA — Total Area of Site in Square Metres

WAT — Nearest Water Source Type: CRK, Creek, RIV, River

ART — Number of Chipped Artefacts on Surface of Site

QZ — Number of Chipped Quartz Artefacts on Surface

QT — Number of Chipped Quartzite Artefacts on Surface

FT — Number of Chipped Flint Artefacts on Surface

SC — Number of Chipped Silcrete Artefacts on Surface

CH — Number of Chipped Chert Artefacts on Surface

CY — Number of Chipped Chalcedony Artefacts on Surface

OR — Number of Chipped Artefacts of Other Raw Materials on Surface

CO — Number of Freehand Percussion Cores on Surface

FL — Number of Flakes on Surface: flakes are all platform remnant bearing chipped pieces

BC — Number of Bipolar Cores on Surface

BF — Number of Bipolar Flakes on Surface

SH — Number of Shatter on Surface: shatter are all non-platform remnant bearing chipped pieces which are not cores

HR — Clay Heat Retainers on Surface: + Present, – Absent

GR — Number of Ground Stone Artefacts on Surface

fracture of the quartz occurred. Machine fractures can duplicate human modifications, but can generally be distinguished because of a lack of patterning or a recent appearance to the fracture, or machine marks on the item. Quartz, however, poses a special problem in that even deliberate human modifications are frequently difficult to identify. This factor, when considered with the possibility of machine modification of stone, creates considerable problems for identifying precontact artefacts made of quartz. Therefore, the author has been cautious in designating broken quartz items as artefacts. For example, if there was one item that appeared to be flaked among several blocky, broken pieces, which were either clearly or even possibly machine-fractured, the item was not considered evidence of a site. On the other hand, if items made of a variety of nonquartz raw materials, undoubtedly modified by flaking were present, then possibly flaked quartz items were recorded as possible artefacts.

Silcrete occurs throughout much of the Otway Range as pebbles to small boulders. The quality ranged from coarse-grained to fine-grained and artefacts were found in all grades. Machine modifications were much more clearly visible and identifiable on this material and little of the problems associated with quartz were encountered.

Flint naturally occurs at several locations on the coast opposite the Otway Range (Scott-Virtue 1982:map 2). It has much more limited spatial distribution in the Otway Range site sample than the other major raw materials, silcrete and quartz. Flint is present at 17 sites and all but two of these are within 3.3 km of the coast. The remaining two sites (7620/127,131) are approximately 18 km inland on the north side of the Otway Range.

Subsurface Survey

As the most immediate use of the Otway Survey results was to provide information and recommendations for a Forest Management Plan being prepared by the Department of Conservation and Environment in Colac, it was anticipated that archaeological concerns in forested portions of the Otway Range would be considered in future prior to logging. This raises serious questions regarding the present ability of archaeologists to predict site locations, much less discover sites in undisturbed forested areas. On a medium scale project like the current survey, areas of forest clearance (e.g. recently ploughed fields, recently logged coupes, forest tracks) which afford excellent surface exposure can be examined to generalise about site distribution and density in forested areas. However, in situations where a specific proposed forested coupe is to be surveyed prior to logging, there will not be such convenient surface exposure. This leaves three options:

(i) allowing sites to be destroyed without field inspection using the justification that they cannot be discovered;
(ii) undertaking a surface survey in the hope that some sites may be found along tracks, in the roots of fallen trees and other minor chance exposures; or
(iii) employing a method of subsurface probing to discover sites.

The last option potentially offers the best opportunity to discover the archaeological sites present and allow management plans to be made and implemented prior to development. Because such a method is not routinely employed in Victorian archaeology, it was necessary to 'field test' it to evaluate the results and determine which of many possible variations of subsurface probing to employ in a given situation. To this end, four field days were applied to experimenting with shovel test sampling in the Otway Range.

It must be stressed that shovel test sampling is not a method of excavating archaeological sites, but rather a site survey method for discovering buried sites or surface sites obscured by surface litter. It involves the excavation of numbers of small, shallow pits within a target area (e.g. a randomly selected quadrat or transect, a judgementally selected area, or development site) for which information on buried site location is required. The location of the pits themselves can be randomly or non-randomly determined.

Several variables must be considered when designing a shovel test sampling strategy for a specific situation, especially the expected frequency, size and depth of sites, and the expected distribution and density of artefacts at sites. These variables will affect decisions regarding the size of the test pits employed, the distance between them and the depth to which they are excavated (Lynch 1980; McManamon 1984; Nance and Ball 1986; Stone 1981).

Methods

Two undisturbed forested areas near the town of Forrest, designated Blocks 27 and 28, were selected for surveying with shovel test sampling (figures 13, 14). One metre square pits excavated to 10 cm below surface were excavated every 10 m along parallel transects, also 10 m apart. This ensured that the areas were sub-surficially probed on a 10 m grid pattern. All sediments were screened with 3 mm mesh sieves. A specially designed test pit sampling record was completed for each pit excavated.

Since a single artefact constitutes a site in this study, the excavation of a pit was halted once an artefact was found. Sites and artefacts discovered this way were recorded in the same manner as sites discovered during other aspects of the survey. Detailed maps were made of each of the shovel test sampling blocks with the aid of a theodolite, which was also used to grid in the test pits. Photographs were taken of all shovel test sampling pits that contained artefacts and of many others before, during and after excavation and after backfilling. The crew was divided into two groups of three persons, with one person in each group digging and recording and two others sieving. Other crew members were involved with mapping, gridding and recording the block.

Results

Survey Blocks 27 and 28 were examined employing shovel test sampling methods (figures 11, 13, 14). Block 27 was gridded into three parallel transects (A, B, C) on which 33 shovel test pits were excavated (figure 13), all but one to a depth of 10 cm below surface. Excavation in square A6 halted when a silcrete flake was discovered; 69% of the square was excavated to 10 cm below surface, while excavation halted at a depth of 5–7 cm below surface in the remaining 31% of the square. A broken quartz flake was subsequently found while sieving matrix already excavated when the first flake was found. These items comprised site 7620/134 (table 4). No additional artefacts were found in this block.

Block 28 was gridded into two parallel transects (A, B) along which 20 shovel test pits were excavated (figure 14). Site 7620/135 was discovered, with artefacts found in squares A8, B4, B5 and B9 (table 4). Forty per cent of B4 was excavated to 10 cm below surface, 25% to approximately 5 cm, and 35% was unexcavated, although the surface litter and turf were removed and sieved. Excavation halted when a small quartz bipolar core was found by one of the sievers. The adjacent square B5 was completely excavated before a bipolar split quartz pebble was recovered by the sievers. Sixty–six per cent of square B9 had been excavated to 10 cm and the remaining 34% had the surface litter and turf removed and sieved when a quartz core rejuvenation flake was recovered in a

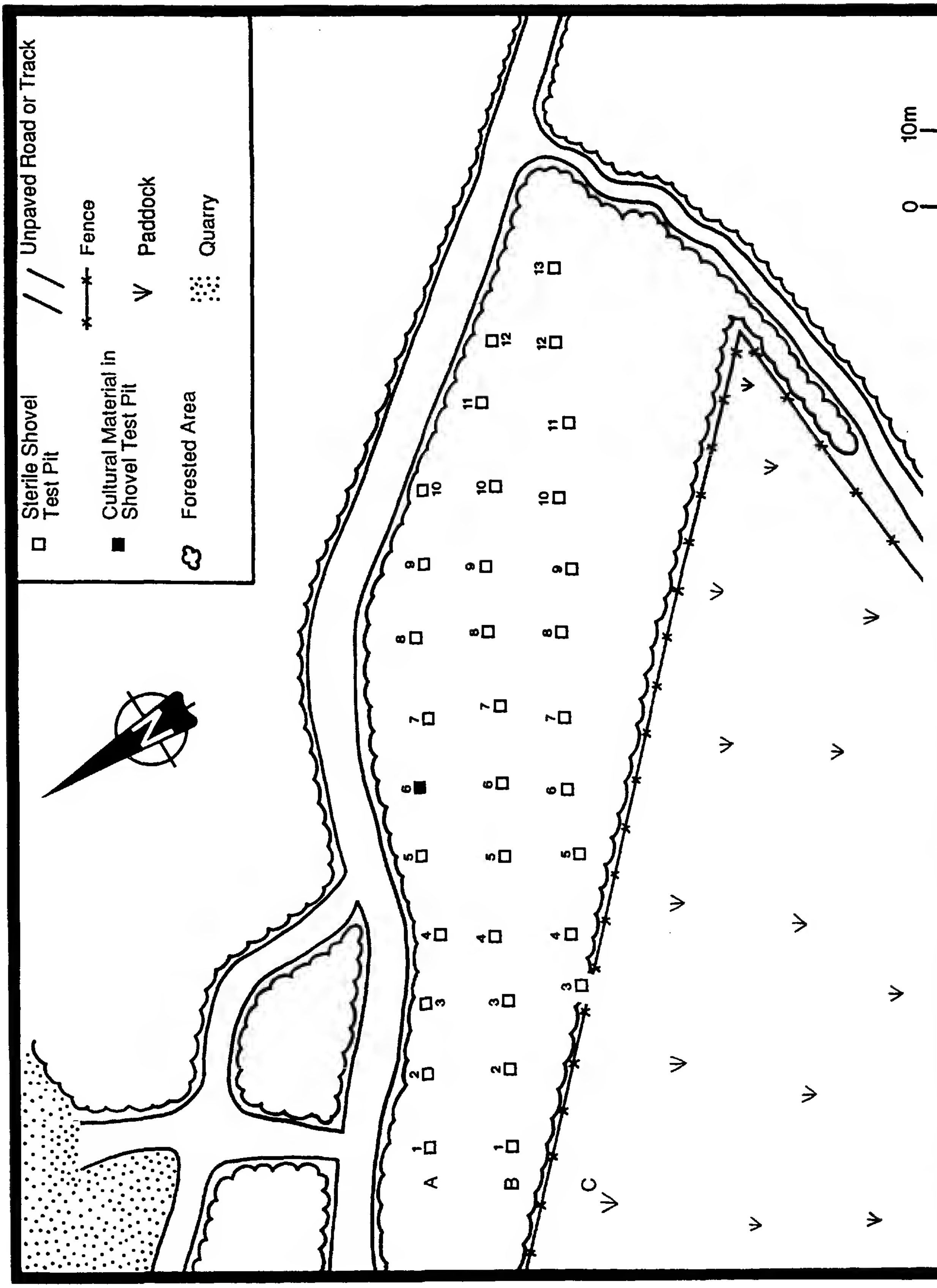


Figure 13. Plan of Otway Survey Block 27 Showing Shovel Test Pit Locations.

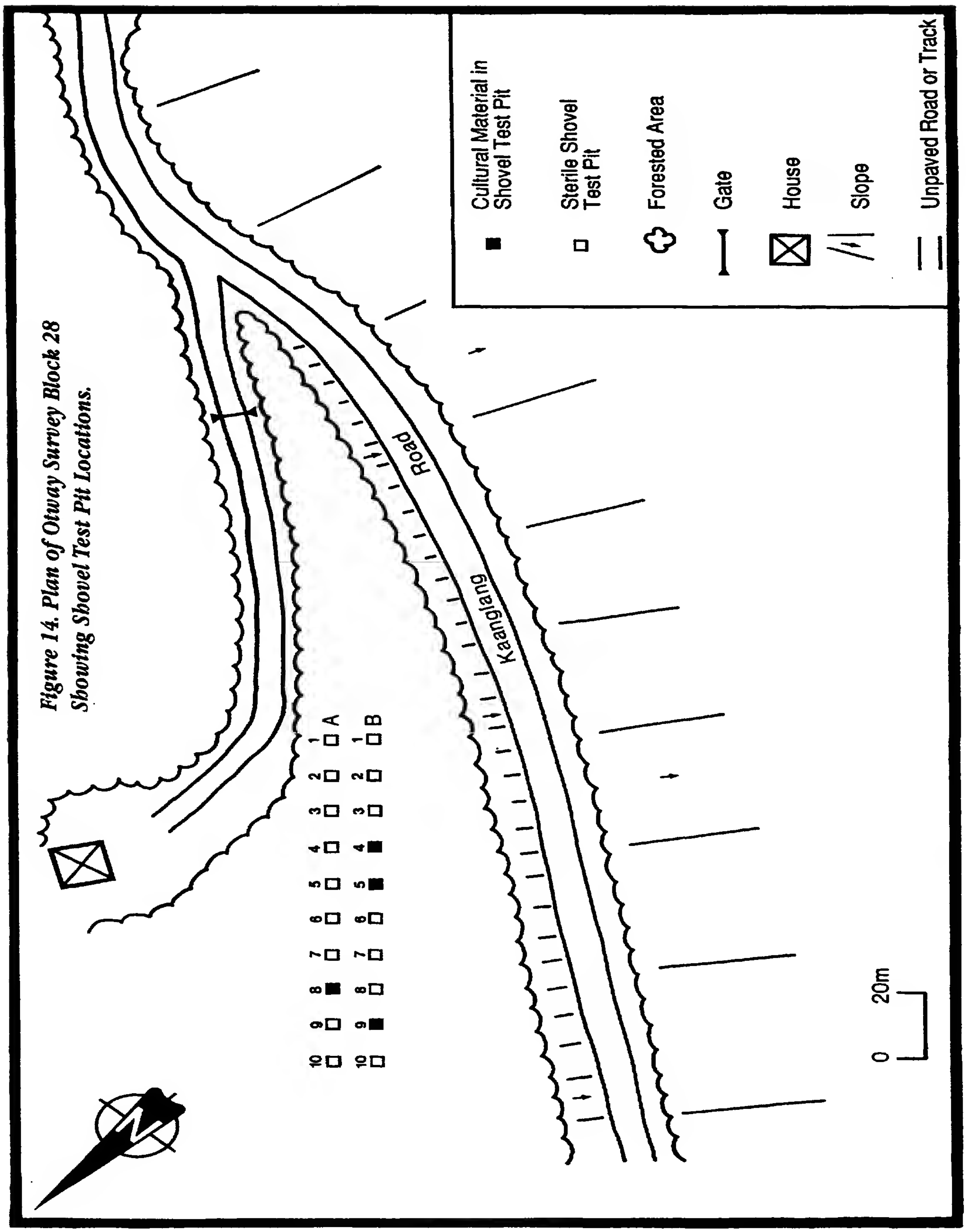


Figure 14. Plan of Otway Survey Block 28 Showing Shovel Test Pit Locations.

sieve. A small piece of coarse quartz flake shatter was also found. A piece of ochre was found in square A8. All other test squares were excavated to 10 cm.

Discussion

Undoubtedly, the shovel testing could have been done differently, and one should approach each situation with a flexible attitude to its application, which should be tailored to the known or anticipated nature of archaeological site size and artefact density. The author has never before found it necessary to employ 1 m^2 pits, but because of the lack of information on artefact density at undisturbed sites and the generally low density previously encountered on disturbed sites, it seemed prudent to use the largest pits practical in forested areas.

It was often necessary to shift the actual location of pits by one metre from the proper grid point (and in one case by two metres) in Block 27 due to the presence of tree trunks or large roots (figure 13). This problem would have been significantly lessened if smaller pits had been employed and significantly exacerbated if a smaller grid size had been employed (a five metre grid had been contemplated). Since the sample units were not chosen by random or stratified systematic unaligned sampling methods, it is not of great importance that several had to be shifted slightly to accommodate trees. If either of those methods had been employed the unfortunate coincidence of pits and trees would have had a devastating effect on the validity of the sample. Interestingly, there were few conflicts between trees and pits in the only slightly less heavily forested Block 28.

The author is convinced that a higher rate of productivity can be achieved in terms of volume excavated/person day than was the case in this pilot project. The crew was largely unaccustomed to subsurface investigations in general and shovel test sampling was completely new to them. Indeed, productivity improved markedly over the three and one half days, with the crew working at a rate of at least 30 shovel test sampling pits a day on the last day versus a total of 33 excavated in the first two and one half days. Improvements in the equipment employed would speed things further. Five or seven millimetre mesh sieves mounted on portable tripods would be a significant improvement over the hand-held 3 mm sieves employed in this experiment. For training purposes, three persons investigated each pit, while the author's previous experience suggests that two person teams are more efficient.

4. Analysis and Predictive Model

Analysis

The investigation of patterning in site distribution and density in the Otway Study Area was not a study of the presence/absence of Aboriginal archaeological sites. Sites were virtually everywhere. Instead, the goal was to identify patterns of differing density of surface manifestations of the regional archaeological record. This involved the exploration of relationships between measures of Aboriginal archaeological density (dependent variables) and environmental attributes (independent variables).

Analysis included the results of the Otway Survey (chapter 3, tables 1–4), as well as the Apollo Bay to Lorne Survey (LTU n.d.), the Apollo Bay Survey (Witter n.d.) and the Aire Valley Survey (Stuart 1979; Head and Stuart 1980). Initially, patterns were only searched for in the Otway Survey data, and virtually all patterns discussed below were first detected or suggested in these data. However, the Otway Survey data often only provided small, and therefore potentially unrepresentative, samples of surveyed areas for several variables under investigation. It was, therefore, necessary to combine data from all four surveys to obtain reasonably representative samples for analysis.

Sample Representativeness

A statistically valid random sample was not available for analysis. Sample representativeness cannot, therefore, be evaluated in a statistical sense, but by the size of surveyed area. In the analyses below, 'sample' refers to the total surface area (m^2) of 'sample units' exhibiting the variable state under investigation (e.g. all sample units with an average elevation of 150 m). Only medium (100,000–499,999 m^2) and large (500,000 m^2 +) samples are considered to be representative and these were relied on as much as possible for evaluating density-environment relationships.

Small samples (10,000–99,999 m^2) were considered to be of dubious representativeness, while very small samples (1–9,999 m^2) were considered to be unreliable. Density values were often extremely high for small and very small samples and these commonly comprised 'outliers' in the data distributions.

Characteristics of the Archaeological Record and Sample Units

Sample units used in the following analyses are fully described in table 3. Aboriginal archaeological sites present within the sample units are described in table 4 (Otway Survey sites only) and in the appendix (all sites).

Visibility of archaeological remains on the ground surface was relatively constant for all sample units, generally in the 70–100 per cent range (table 3). Therefore, bias introduced by differing patterns of surface visibility was not a problem. This does not, however, mean that all sites in the study area were visible on the ground surface at the time of survey. Sites on landform elements where the aggradation of natural sediments occurred may have been deeply buried. These elements include lower slopes, valley flats, floodplains and river terraces. Nevertheless, the ground disturbance present in most sample units, either from ploughing, logging or grading, would have presumably brought at least traces of many of these sites to the surface.

Witter (n.d.) made a good case for attributing most of his Apollo Bay survey sites to the 'Late Prehistoric period', dating between ca. 5000 and 150 BP. The few potentially earlier sites identified by Witter (n.d.) and Stuart (1979) were not included in the following analyses. Sites discovered by the Otway Survey and other surveys were estimated to be less than 5000 years old on the evidence of their stone technology, raw material use and site location. Undoubtedly, some of these sites predate 5000 BP, but it was assumed that these were few and would not appreciably blur site distribution patterns. All conclusions reached in this chapter should be considered to apply only to the 5000–150 BP period.

Measures of Aboriginal Archaeological Density

Archaeological sites per square kilometre (SITEDENS) is a useful density measure. In some situations, however, it does not adequately represent the density of Aboriginal occupation. Such a case would be where similar numbers of sites of dramatically different sizes are present in two areas; for example, large artefact scatters in one area and small, sparse artefact scatters in another. This measure is calculated by dividing the total number of sites observed by the number of square kilometres surveyed.

Another useful density measure is the number of chipped stone surface artefacts per square kilometre (ARTDENS). This measure is calculated on the basis of the total number of artefacts manifested on the surface of all sites within a survey area. It is particularly vulnerable to providing misleading results if the ground surface visibility is markedly different between two areas under comparison or if artefact collectors have been active in one area and not another. This measure is calculated by dividing the total number of artefacts observed by the number of square kilometres surveyed.

Yet another measure of density is the total area of all sites in a surveyed area represented as a percentage of the area surveyed: total site area (m^2) x 100/total area surveyed (m^2). This measure (SITEAREA%) produces a value which represents the percentage of the surface of a given surveyed area that is occupied by sites. In some ways, this measure better reflects Aboriginal archaeological density than the other two. It particularly emphasises coastal shell middens which can be low in numbers and in surface artefacts, but large in surface area.

Although each of the three measures is effective in many situations, it is cumbersome to deal with three measures in multiple analyses, especially where it is necessary to discuss and explain seemingly contradictory results between the various density measures. Therefore, a new measure of density, archaeological density ARCHDENS), has been defined. ARCHDENS is: (SITEDENS x ARTDENS x SITEAREA %)/1000. ARCHDENS values lack intrinsic meaning, but it is a useful relative measure for comparative intra-regional analysis. It was the only measure subjected to statistical analyses.

Procedure

It is important that the reader understand the relationships between sampling strata, survey blocks and sample units. The sampling strata were employed to direct field survey to target landforms, but are not used in the analysis. Each locality surveyed in the field (or 'survey block') was comprised of one or more landform element types. Each specific surveyed landform element, including its environmental and archaeological attributes, comprises a 'sample unit'. The 'survey block' itself is not employed as a unit of analysis.

The analysis discussed below is concerned with investigating the relationships between characteristics of the archaeological record and features of the natural environment. The author wanted to learn how archaeological density varied against the different states of each environmental variable. To accomplish that, all sample units that corresponded to a specific environmental variable state were combined and the archaeological density calculated for the aggregate.

An example will illustrate the analytical procedure. In the case of elevation, a variable named ELEVATION was created. The range of elevation in the sample units was identified as lying between 5 m and 540 m above sea level; this range was then divided into 50 m elevation intervals. Next, sample units whose average elevation fell within each 50 m interval were identified; most intervals had several sample units within them (table 3). The aggregate density-related characteristics of the sites found in the sample units in each interval were then calculated (table 14). These estimates were searched for obvious patterning and then subjected to statistical analysis. As a preliminary step in this analysis, the characteristics of the data were illustrated as box and whiskers plots and histograms (figure 20) and descriptive statistics were calculated for each of the density variable values (table 15) using the Kwikstat Statistical Data Analysis Program, Version 4 (Elliot 1994). Further analysis involved only the ARCHDENS density variable and the ELEVATION environmental variable. As ARCHDENS was clearly not normally distributed, the non-parametric Spearman Rank Order Correlation technique was employed (Fletcher and Lock 1994:110). Spearman correlations were also calculated with the aid of the Kwikstat Program. Finally, the correlation result and the relationship between the ARCHDENS and ELEVATION variables were discussed and summarised into a statement of the nature on the relationship.

The same procedure of combining sample units used for the elevation example was employed in the other analyses. It should be noted that the combinations of sample units were different for each environmental variable examined. The fact that several analyses produced similar or complementary patterns indicates the strength of this approach.

Distance From Ocean

The relationship between ARCHDENS and distance from the ocean is investigated by combining all sample units within 1 km intervals of distance inland from the shore line (variable DISTANCE FROM OCEAN). The densities within 14 intervals from the ocean to 15 km inland are presented in table 5. Fifteen kilometres from the ocean is used as the cut-off for this analysis as this distance encompasses the plain, foothills and upper slopes of the coastal side of the range. The plateau capping the range is also included, but not the inland (northern) slopes or foothills which are discussed in the Distance from Plain section below.

A perusal of the raw data in table 5 reveals that archaeological density tends to decline as distance away from the ocean increases up to approximately 6 km, where the density drops abruptly to a generally low level that continues over the next 9 km. When these raw data are subjected to descriptive statistics and graphics, one distance interval is consistently identified as an outlier for the various measures of density: 5.0–5.99 km (figure 15d, tables 5, 6). Examination of the sample units within this interval revealed that one sample unit was actually a large site with an additional buffer area surveyed around it rather than a survey area with a site discovered within it. For this reason, the following analyses are conducted both with the 5.0–5.99 km interval data included and without it.

Figure 15. Box and Whiskers Plots and Histograms for Density Variable Values Used in the Distance from Ocean Analysis (Kwikstat Version 4, Elliot 1994): a. SITEDENS; b. ARTDENS; c. SITEAREA%; d. ARCHDENS

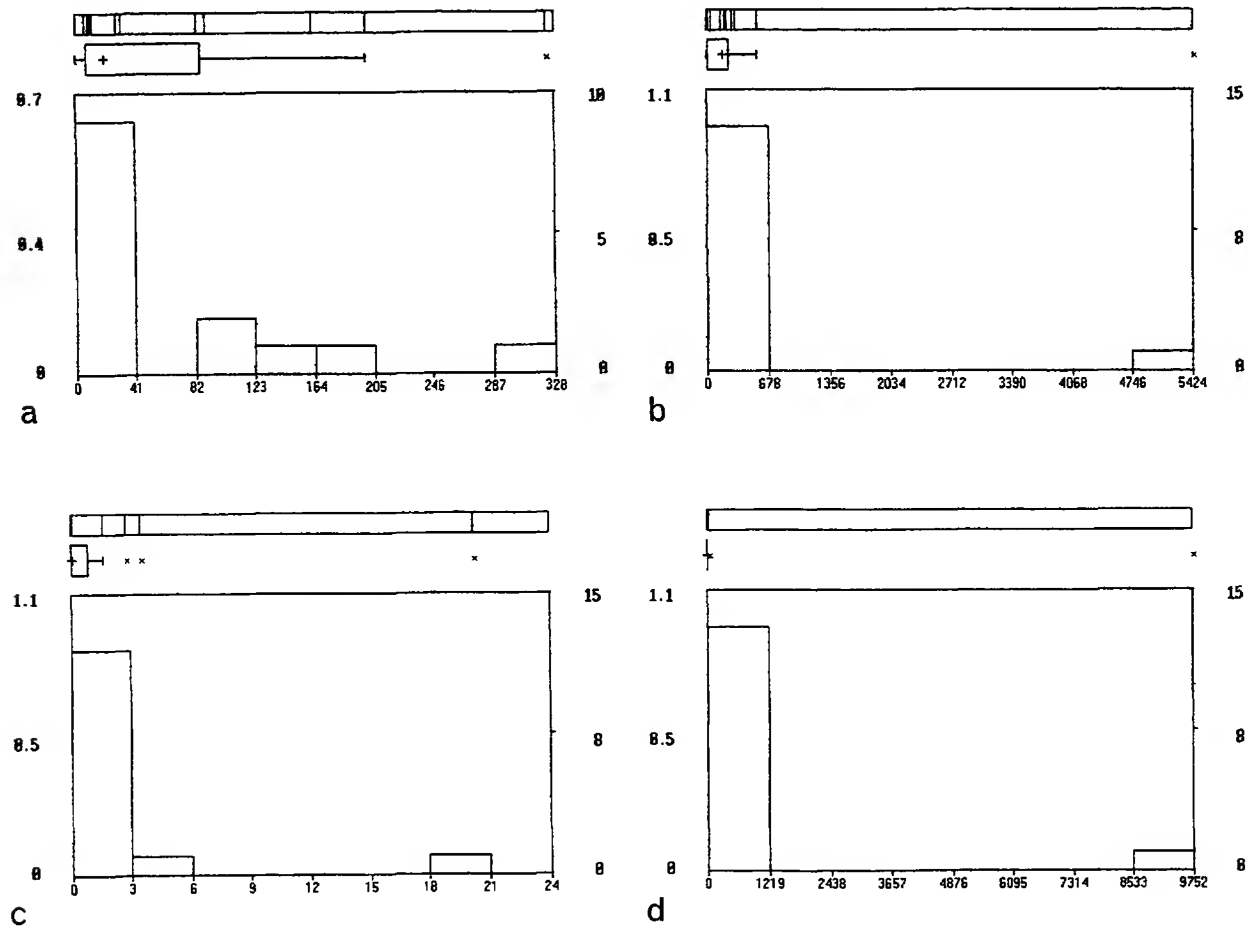


Table 5. Density Variable Values for 1 km Distance Intervals from the Ocean.

Distance from Ocean (km)	Area Surveyed (km^2)	SITEDENS	ARTDENS	SITEAREA%	ARCHDENS
0.99	4.32428	31.68	206.51	3.53000	23.09
1.99	2.28098	10.52	228.41	2.78000	6.68
2.99	0.89840	27.83	279.39	1.61000	12.52
3.99	0.01850	162.16	162.16	0.01600	0.42
4.99	0.03620	82.87	552.49	0.06000	2.75
5.99	0.02250	88.89	5422.22	20.22000	9745.66
6.99	0.00000	0.00	0.00	0.00000	0.00
7.99	0.00100	0.00	0.00	0.00000	0.00
8.99	0.11370	8.80	8.80	0.00090	0.00007
9.99	0.07000	0.00	0.00	0.00000	0.00
10.99	0.42950	11.64	46.57	0.07100	0.38
11.99	0.00620	322.58	322.58	0.03200	3.33
12.99	0.15000	200.00	200.00	0.02000	0.80
13.99	0.20810	0.00	0.00	0.00000	0.00
14.99	0.16640	6.01	6.01	0.00060	0.00002

Note: Density variables are defined on page 46.

Table 6. Descriptive Statistics for Density Variable Values Used in the Distance from Ocean Analysis.

Variable	n	Mean	Med	Min	Max	SD	Sem	Var	CVar	Norm
SITEDENS	14	68.07	19.74	0.0	322.58	93.50	25.93	9414.70	1.43	no
ARTDENS	14	531.08	181.08	0.0	5422.22	1365.46	378.71	2007890.00	2.67	no
SITEAREA%	14	2.02	0.03	0.0	20.22	5.17	1.43	28.79	2.65	no
ARCHDENS	14	699.64	0.40	0.0	9745.66	2508.92	695.85	6778902.00	3.72	no

Note: Density variables are defined on page 46.

Table 7. Spearman Rank Order Correlation Coefficient for Variables ARCHDENS and DISTANCE FROM OCEAN (0.99–14.99 km) (Elliot 1994; Mendenhall et al. 1989: Appendix table 10).

Variables	n	Correlation Coefficient	Critical Value (0.05)
ARCHDENS, DISTANCE FROM OCEAN (0.99–14.99 km intervals)	14	–0.66	–0.457
ARCHDENS, DISTANCE FROM OCEAN (0.99–14.99 km intervals)	13	–0.69	–0.475

The Spearman's Rank Order Correlation Coefficients for variables ARCHDENS and DISTANCE FROM OCEAN are presented in table 7. ARCHDENS and DISTANCE FROM OCEAN have a correlation of –0.66 with the 5.0–5.99 km data included and –0.69 without them. This relationship is represented by the XY plot of ARCHDENS and DISTANCE FROM OCEAN on figure 16a with a computer-generated linear trend line. The overall relationship is not truly linear, however, as the density is high near the ocean and decreases markedly to a low but fairly constant level beyond about 5 km distance from the ocean. This relationship is better represented by the curve fitted to the XY plot on figure 16b.

The five distance intervals from the ocean to 5 km inland (intervals 0.99–4.99 km) were subject to further analysis. No outliers were identified in the descriptive statistics and graphics (figure 17d, table 8). The Spearman's Rank Order Correlation Coefficient for ARCHDENS and DISTANCE FROM OCEAN 0.99–4.99 km intervals is presented in table 9. ARCHDENS and DISTANCE FROM OCEAN (to 5 km) have a correlation of –0.80, although this does not exceed the critical value of –0.90 where n=5. Nevertheless, the relationship can be described as inversely linear as is apparent on the XY plot with computer generated trend line (figure 18).

It is concluded that:

> *Archaeological density is high at distances less than 5 km from the ocean and is much lower at distances of 5 km to 15 km from the ocean. Archaeological density decreases in a linear fashion with increasing distance up to 5 km from the ocean.*

Figure 16. XY Plots of Archaeological Density vs. Distance from Ocean (13 Intervals/Data points) (Kwikstat Version 4, Elliot 1994): a. with computer generated linear trend line; b. with curve.

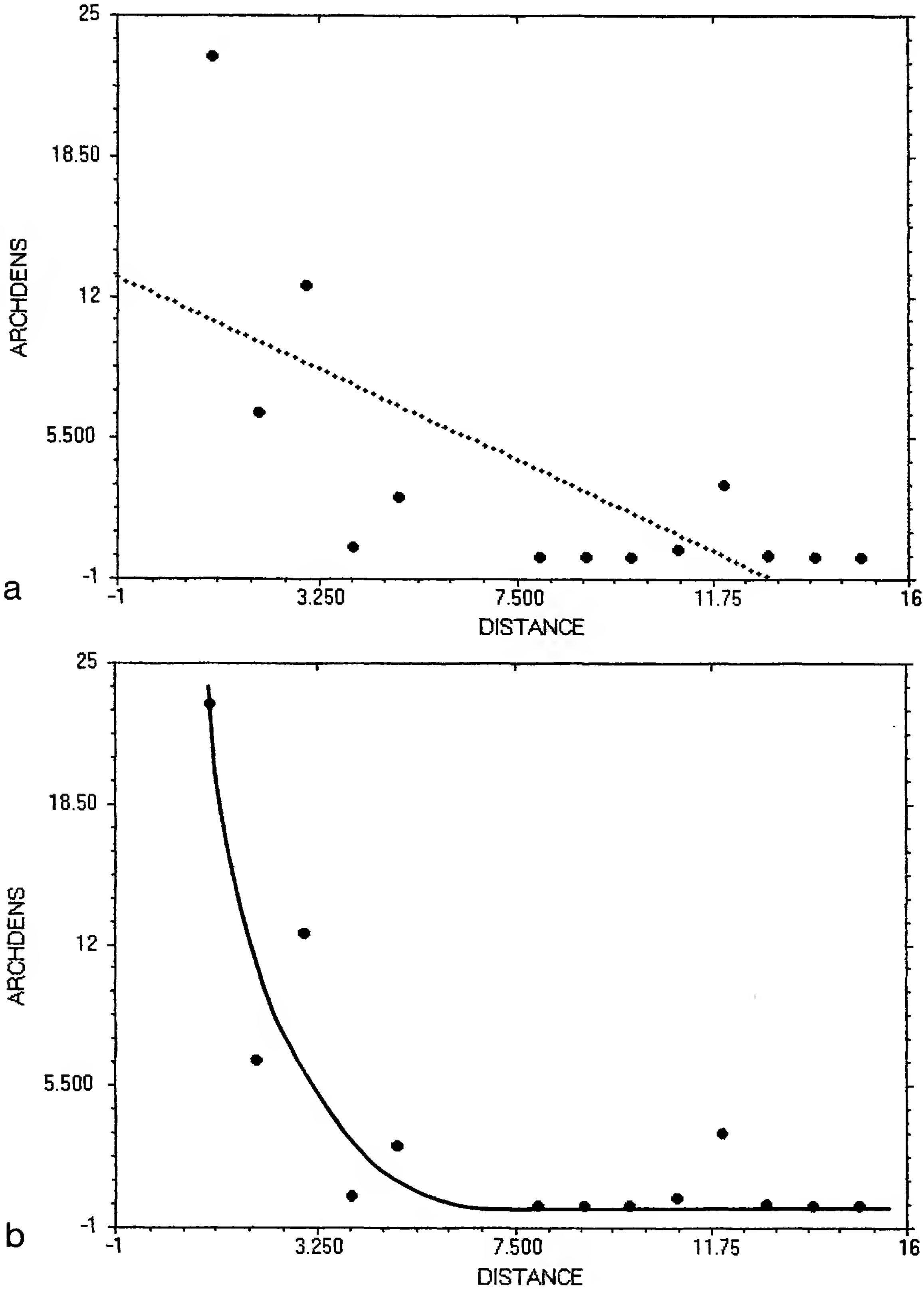


Figure 17. Box and Whiskers Plots and Histograms for Density Variable Values in the 0.99 km to 4.99 km Intervals Used in the Distance from Ocean Analysis (Kwikstat Version 4, Elliot 1994): a. SITEDENS; b. ARTDENS; c. SITEAREA%; d. ARCHDENS.

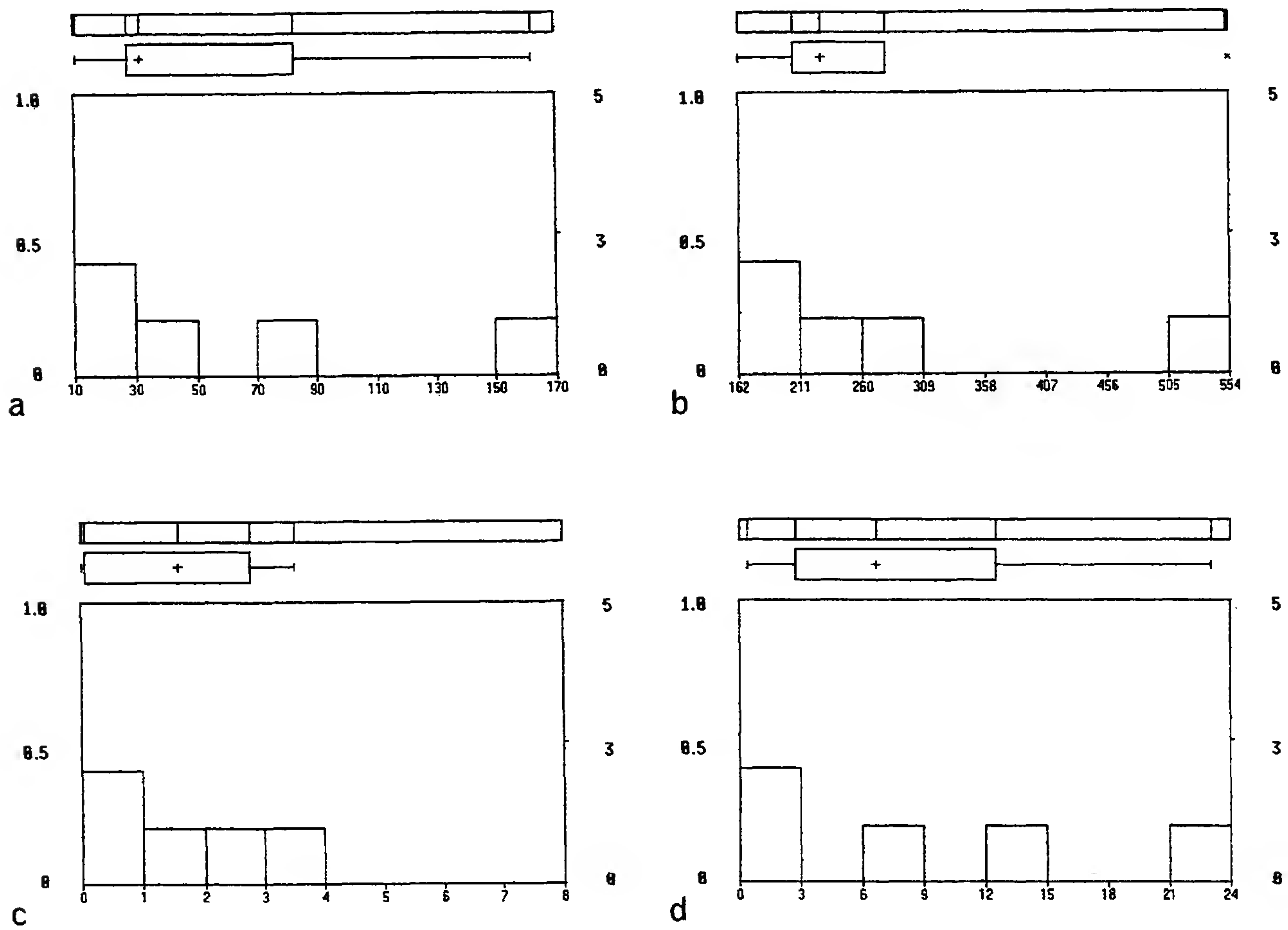


Table 8. Descriptive Statistics for Density Variable Values for the 0.99 km to 4.99 km Distance Intervals in the Distance from Ocean Analysis.

Variable	n	Mean	Med	Min	Max	SD	Sem	Var	CVar	Norm
SITEDENS	5	63.01	31.68	10.52	162.16	55.14	27.57	3799.89	0.98	no
ARTDENS	5	285.79	228.41	162.16	552.49	138.59	69.29	24008.00	0.54	no
SITEAREA%	5	1.60	1.61	0.02	3.53	1.41	0.71	2.50	0.99	no
ARCHDENS	5	9.09	6.68	0.42	23.09	8.11	4.06	82.23	1.00	no

Note: Density variables are defined on page 46.

Figure 18. XY Plot of Archaeological Density vs. Distance from Ocean for 0.99 km to 4.99 km Intervals with Computer Generated Linear Trend Line (Kwikstat Version 4, Elliot 1994).

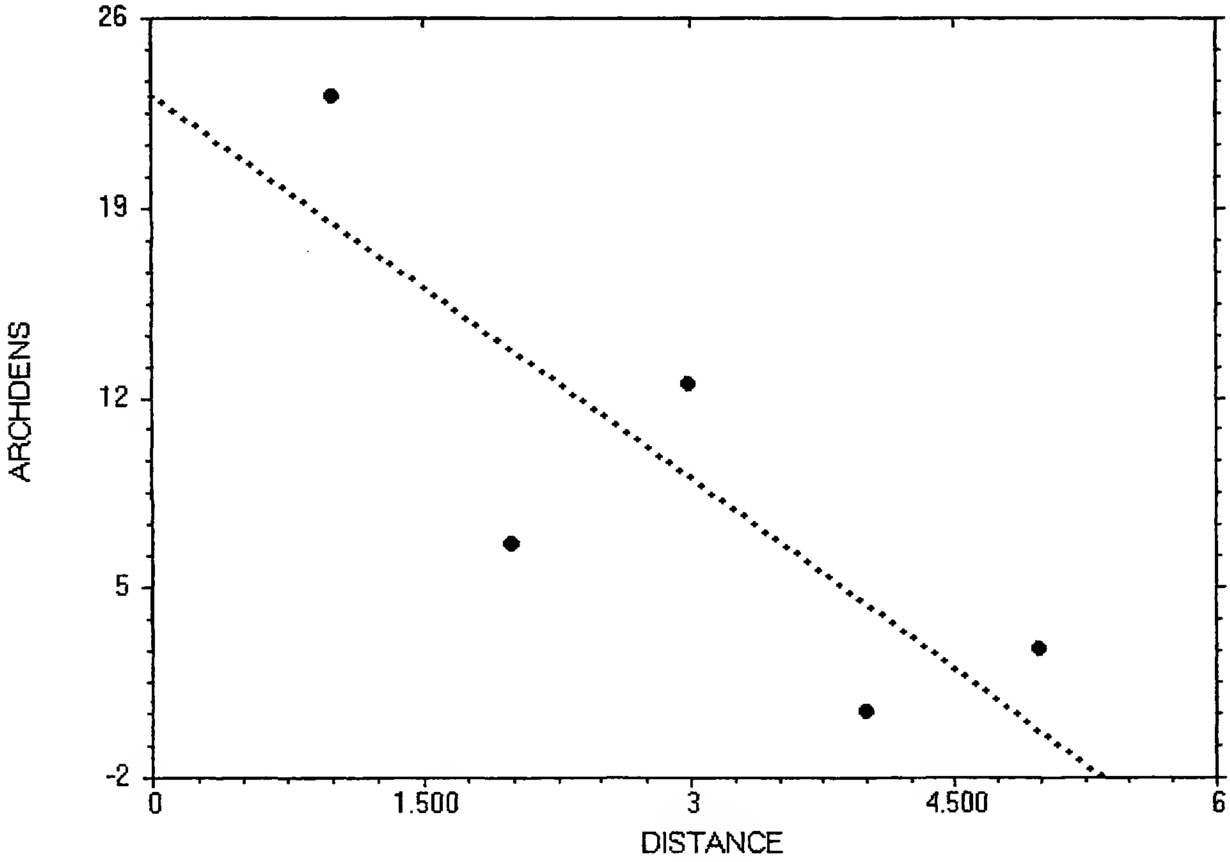


Table 9. Spearman Rank Order Correlation Coefficient for Variables ARCHDENS and DISTANCE FROM OCEAN (0.99–4.99 km) (Elliot 1994; Mendenhall et al. 1989: Appendix table 10).

Variables	n	Correlation Coefficient	Critical Value (0.05)
ARCHDENS, DISTANCE FROM OCEAN (0.99-4.99 km intervals)	5	–0.80	–0.90

Distance From Inland Plain

The impression derived from the field survey was that archaeological density is higher in the northern foothills of the Otway Range than in the adjacent upper slopes and plateau. One way to explore this possible pattern is to examine the relationship between density and the foothill/plain margin. Distance from the plain south into the foothills is measured in 1 km intervals to 11 km, the greatest distance for which data are available (variable DISTANCE FROM PLAIN). Only Otway Survey sample units are available for this area and there is a general problem with small survey areas for many of the intervals. There are no data at all for the 5.0–5.99 km interval.

Examination of the density values, descriptive statistics and graphs point out two consistent outlier intervals for the density measures: 4.00–4.99 km and 10.00–10.99 km (tables 10, 11, figure 19). Examination of the surveyed areas, which are small (4.00–4.99 km) to extremely small (10.00–10.99 km), suggests they should be deleted from the analysis because of their size. Once these have been deleted, the density information for interval 9.00–9.99 km stand out as extreme outliers. Again, the very small size of the surveyed area is a likely reason for the anomalously high densities and this interval is also deleted from the analysis. Spearman Rank Order Correlation Coefficients are calculated using the remaining seven datapoints (intervals) (table 12). A coefficient of –0.75 was obtained for ARCHDENS and DISTANCE FROM PLAIN, just exceeding the critical value of –0.71 for n=7 at the 0.05 significance level.

Table 10. Density Variable Values for 1 km Distance Intervals from the Inland Plain. Otway Survey Data Only.

Distance From Plain (km)	Area Surveyed (km^2)	SITEDENS	ARTDENS	SITEAREA%	ARCHDENS
0.99	0.27000	3.70	3.70	0.0004	0.00001
1.99	0.11480	52.30	34.80	0.04	0.07
2.99	0.07810	64.00	25.60	0.07	0.11
3.99	0.10440	0.00	0.00	0.00	0.00
4.99	0.02390	4393.30	292.90	20.88	26868.33
5.99	0.00000	0.00	0.00	0.00	0.00
6.99	0.02860	0.00	0.00	0.00	0.00
7.99	0.00350	0.00	0.00	0.00	0.00
8.99	0.00820	0.00	0.00	0.00	0.00
9.99	0.00620	322.60	322.60	0.03	3.36
10.99	0.00050	2000.00	2000.00	0.20	800.00

Table 11. Descriptive Statistics for Density Variable Values Used in the Distance from Plain Analysis.

Variable	n	Mean	Med	Min	Max	SD	Sem	Var	CVar	Norm
SITEDENS	10	683.59	28.00	0.0	4393.30	1368.91	456.30	2082116.00	2.11	no
ARTDENS	10	267.96	14.65	0.0	2000.00	589.38	196.46	385968.00	2.32	no
SITEAREA%	10	2.12	0.02	0.0	20.88	6.25	2.08	43.45	3.11	no
ARCHDENS	10	2767.19	0.03	0.0	26868.33	8037.25	2679.08	71774886.00	3.06	no

Note: Density variables are defined on page 46.

Figure 19. Box and Whiskers Plots and Histograms for Density Variable Values Used in the Distance from Plain Analysis (Kwikstat Version 4, Elliot 1994): a. SITEDENS; b. ARTDENS; c. SITEAREA%; d. ARCHDENS.

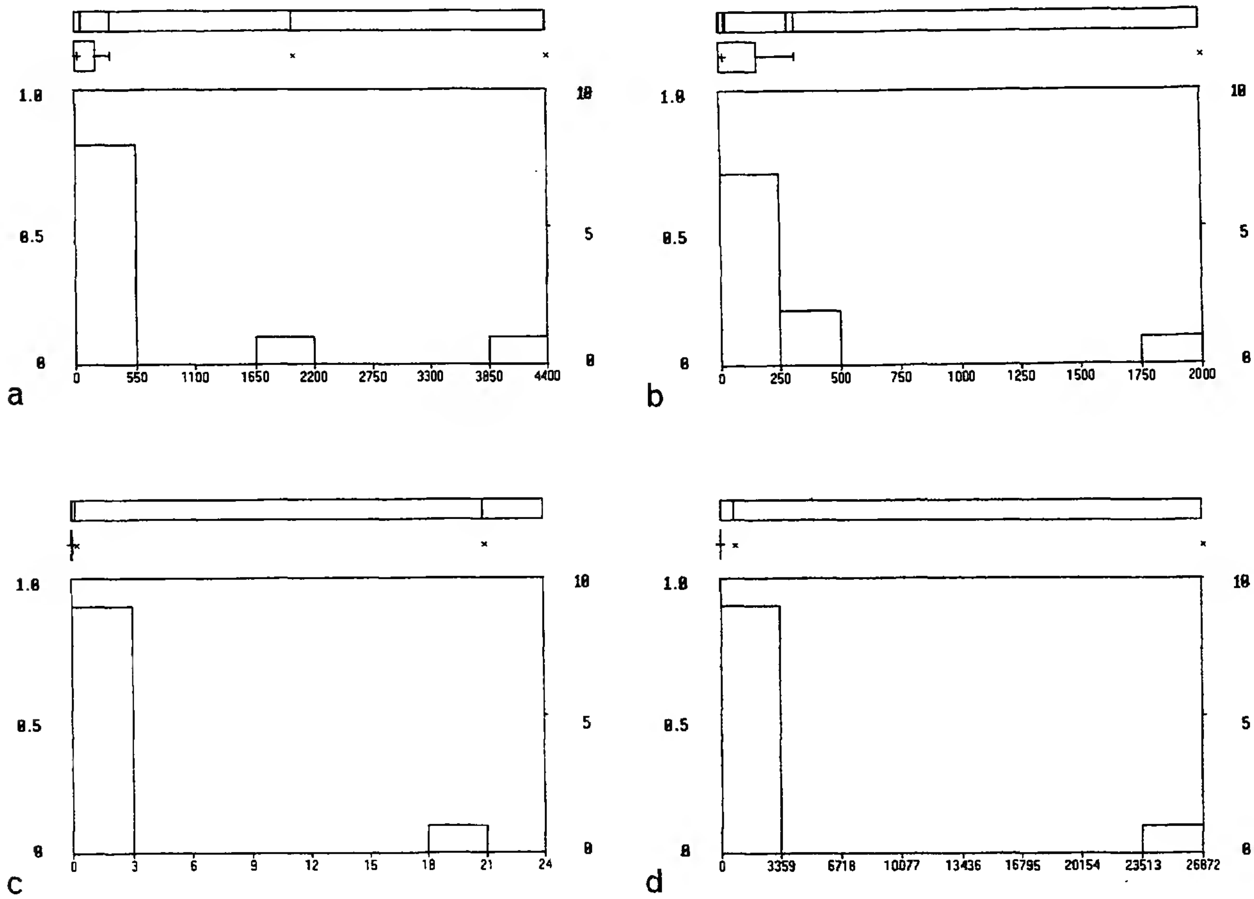


Table 12. Spearman Rank Order Correlation Coefficient for Variables ARCHDENS and DISTANCE FROM PLAIN (Elliot 1994; Mendenhall et al. 1989: Appendix table 10).

Variables	n	Correlation Coefficient	Critical Value (0.05)
ARCHDENS, DISTANCE FROM PLAIN	7	–0.75	–0.714

Table 13. Density Variable Values for Sample Units <5 km from the Inland Plain and Sample Units 5–11 km from the Inland Plain.

Distance from Plain (km)	Area Surveyed (m^2)	SITEDENS	ARTDENS	SITEAREA%	ARCHDENS
0.0–4.99	591,200	23.68	197.90	0.86028	4.03151
5.0–10.99	47,000	63.83	63.83	0.00638	0.02599

Note: Density variables are defined on page 46.

It is acknowledged that the results of this analysis are open to question due to the inclusion of some intervals with very small surveyed areas and the exclusion of others because the densities appeared to be anomalously high. They are interpreted here as anomalous partly because of the prior expectation that densities should be low at distances far from the plain. A stronger reason for excluding these data is that the density figures themselves are impossibly high (table 10). Another point to consider is that the exclusion of other intervals with very small surveyed areas leaves too few data points beyond 6.99 km to attempt analysis. Another way of examining the data that does not involve the discretionary inclusion or exclusion of distance interval density data is discussed below.

To test the proposition that densities are higher at distances closer to the foothill/plain boundary than at distances farther away, all of the sample unit data from 0 to 4.99 km distance were lumped together to obtain a density measure to contrast against the combined data from 5.00–10.99 km distance. The results supported the perceived patterning: archaeological density is 4.03151 in the 0–4.99 km zone versus 0.02599 in the 5.0–10.99 km zone (table 13).

In conclusion:

Archaeological density in the northern Otway Range is high at distances less than 5 km from the foothill/plain boundary and much lower at distances between 5 and 11 km.

Elevation

Elevation is divided into eleven 50 m intervals above sea level (variable ELEVATION). Archaeological density of combined sample units falling within the intervals is presented in table 14. Examination of this table reveals that lower elevation intervals generally have higher archaeological density values than higher elevations.

Moving on to descriptive statistics and graphics, the extremely small size of the surveyed area within the 550 m interval is a good enough reason to delete the interval and its density figures from further consideration (tables 14, 15, figure 20). There is also one extreme outlier for three of four density measures—the 300 m interval. The reasons for this are not clear, but perhaps the relatively small survey area is sufficient reason for excluding it from statistical analysis. The remaining nine data points between 50 and 500 m elevation have been used to calculate

Table 14. Density Variable Values for 50 m Elevation Intervals.

ELEVATION (m)	AREA SURVEYED (km^2)	SITEDENS	ARTDENS	SITEAREA%	ARCHDENS
50	5.00689	26.96	177.76	3.64	17.44
100	2.57095	10.50	200.70	1.32	2.78
150	0.05773	173.24	831.53	0.29	41.78
200	0.33440	56.82	645.93	4.26	156.35
250	0.11970	58.48	100.25	0.08	0.47
300	0.03990	175.44	2631.58	12.51	5775.67
350	0.02030	0.00	0.00	0.00	0.00
400	0.12660	7.90	7.90	0.0008	0.0001
450	0.67700	29.54	29.54	0.003	0.003
500	0.66270	16.60	245.96	1.42	5.80
550	0.00940	212.77	212.77	0.02	0.91

Note: Density variables are defined on page 46.

Figure 20. Box and Whiskers Plots and Histograms for Density Variable Values Used in the Elevation Analysis (Kwikstat Version 4. Elliot 1994): a. SITEDENS; b. ARTDENS; c. SITEAREA%; d. ARCHDENS.

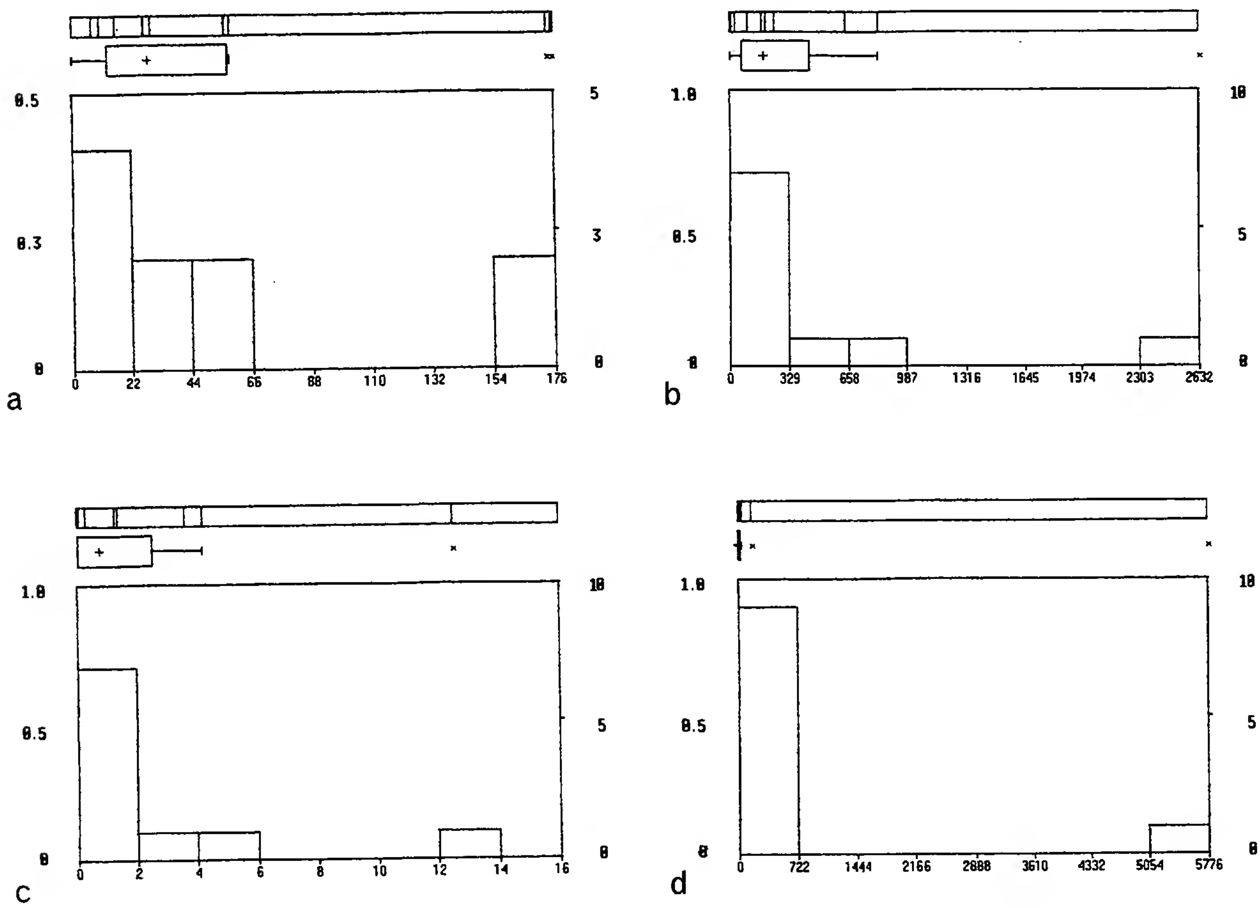


Table 15. Descriptive Statistics for Density Variable Values Used in the Elevation Interval Analysis.

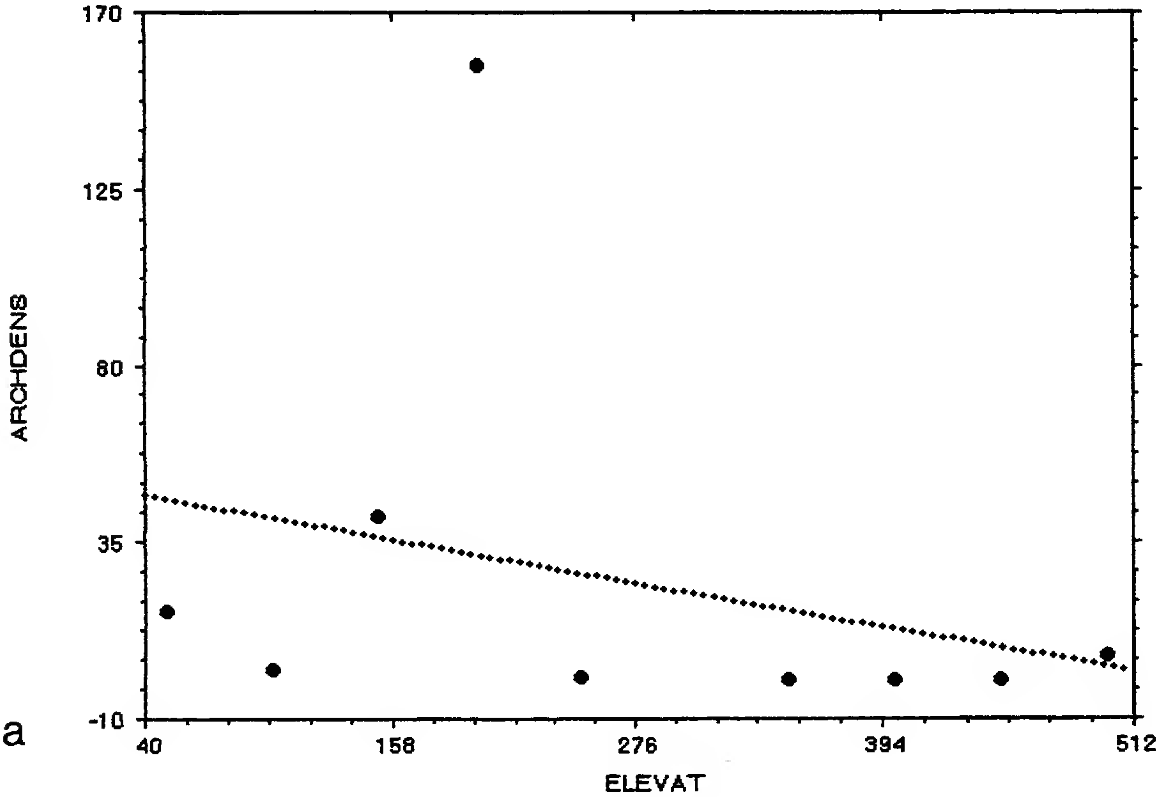
Variable	n	Mean	Med	Min	Max	SD	Sem	Var	CVar	Norm
SITEDENS	11	69.84	29.54	0.0	212.77	74.53	23.57	6110.32	1.12	no
ARTDENS	11	462.18	200.70	0.0	2631.58	730.68	231.06	587285.00	1.66	no
SITEAREA%	11	2.14	0.29	0.0	12.51	3.59	1.13	14.14	1.76	no
ARCHDENS	11	545.57	2.78	0.0	5775.67	1654.49	523.20	3011084.00	3.18	no

Note: Density variables are defined on page 46.

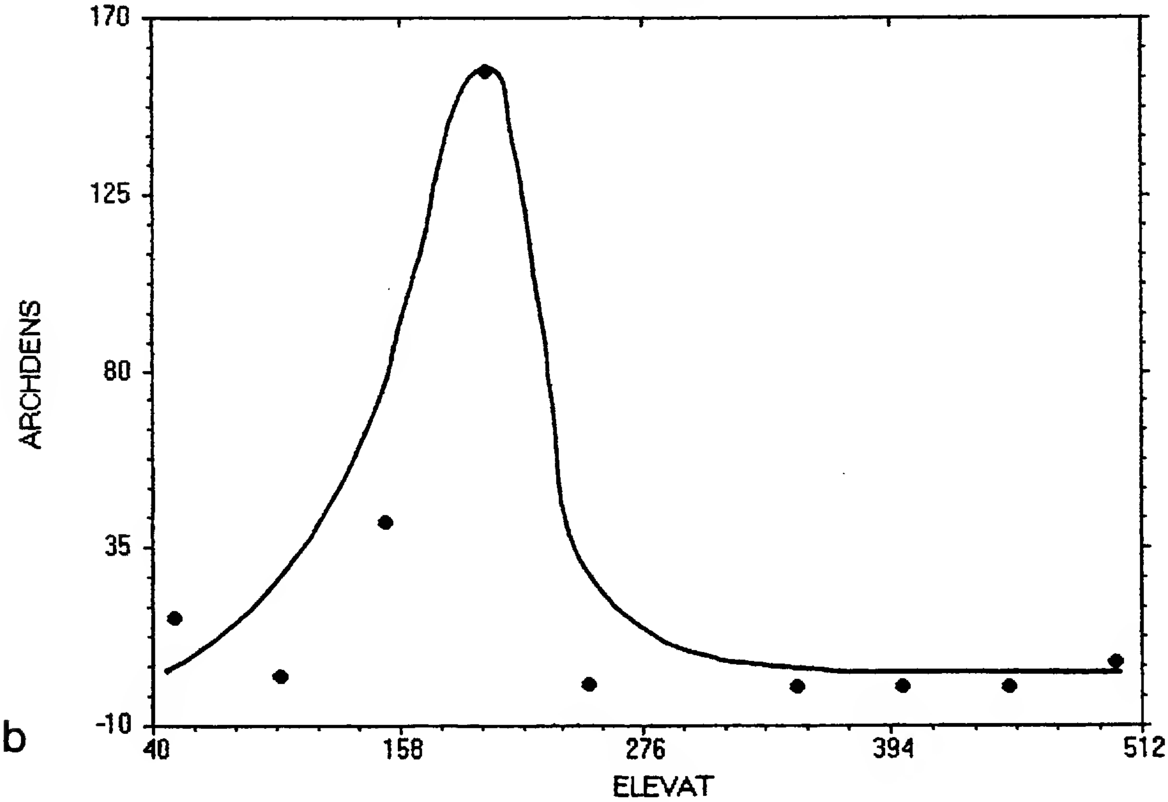
Table 16. Spearman Rank Order Correlation Coefficient for Variables ARCHDENS and ELEVATION (Elliot 1994; Mendenhall et al. 1989: Appendix table 10).

Variables	n	Correlation Coefficient	Critical Value (0.05)
ARCHDENS, ELEVATION	9	–0.51	–0.60

Figure 21. XY Plots of Archaeological Density vs. Elevation (Nine Intervals/Data Points) (Kwikstat Version 4, Elliot 1994): a. with computer generated linear line; b. with curve.



a



b

Spearman Rank Order Correlation Coefficients for ARCHDENS and ELEVATION (table 16). A coefficient of –0.51 was obtained, but this does not exceed the 0.05 significance level threshold and must be considered a weakly negative correlation.

The XY plot of ARCHDENS and ELEVATION indicates some propensity for archaeological density to decrease as elevation increases, although the computer-generated trend line does not approximate this relationship well (figure 21a). The fitted curve on figure 21b more closely reflects the non-linear relationship between the two variables: ARCHDENS is high up to about 200 m elevation, where it drops abruptly to a much lower density level for higher elevations. This pattern reflects the high archaeological densities along the peripheries of the Otway Range—these being areas of lower elevation. Elevations of 200 m are often reached within 2 km of the ocean and rarely at distances greater than 5 km. On the northern periphery of the Otway Range, 200 m elevations are reached within similar distances from the edge of the plain.

In conclusion

Archaeological density increases up to 200 m elevation and abruptly decreases thereafter to a much lower density level that continues to 500 m elevation.

Table 17. Density Variable Values for 50 m Distance Intervals from Freshwater.

Distance from Fresh-water (m)	Area Surveyed (km^2)	SITEDENS	ARTDENS	SITEAREA%	ARCHDENS
50	0.31476	19.06	1115.14	3.51	74.60
100	0.99470	25.13	545.89	2.00	27.44
150	1.43468	14.64	89.22	2.49	3.25
200	1.13440	28.21	392.28	5.60	61.97
250	1.06180	37.67	195.89	2.24	16.53
300	0.22675	30.87	621.83	14.51	278.53
350	0.92740	18.33	25.88	1.23	0.58
400	0.27600	39.86	39.86	0.61	0.97
450	0.00000	0.00	0.00	0.00	0.00
500	0.37580	21.29	37.25	4.30	3.41
550	0.00000	0.00	0.00	0.00	0.00
600	0.09040	11.06	99.56	0.01	0.01
650	0.00000	0.00	0.00	0.00	0.00
700	0.75000	2.67	12.00	2.61	0.08
750	0.00000	0.00	0.00	0.00	0.00
800	0.30295	6.60	85.82	0.20	0.11
850	0.32500	6.15	15.39	0.11	0.01
900	0.00000	0.00	0.00	0.00	0.00
950	0.00000	0.00	0.00	0.00	0.00
1000	0.80000	56.25	46.25	0.81	2.11

Note: Density variables are defined on page 46.

Distance from Freshwater

The relationship between ARCHDENS and DISTANCE FROM FRESHWATER is investigated by examining density in 50 m distance intervals from all permanent freshwater sources represented on 1:25,000 topographic maps. The density/distance data as presented in table 17 indicate some obvious patterning, most notably the generally high density values within 300 m of water.

These data, however, are not suitable for statistical analysis and several modifications must be made. There are twenty-three 50 m intervals up to 1150 m distance from freshwater. Of those, seven intervals have no corresponding surveyed areas (intervals 450 m, 550 m, 650 m, 900 m, 950 m, 1050 m, 1100 m from freshwater). Two others (750 m, 1150 m) have extremely small, and therefore potentially unrepresentative, surveyed areas. These nine intervals are excluded from statistical treatment, leaving 14 intervals between 50 m and 1000 m.

The 1000 m distance interval values are seemingly anomalous. The surveyed area consists of a very large sample unit containing 45 archaeological sites along the Aire Valley coast (table 3). Two obvious problems exist with this sample unit. First, portions of it are much closer to freshwater than the 1000 m of its centrepoint and some are much farther distant. Second, water sources may have been available in the past that are not marked on the 1:25,000 topographic maps used to identify water sources for this study. The area has been subjected to much shifting of sand in the historic period and this may have buried additional water sources that were available in precontact times. Because of a reluctance in accepting the figures for the 1000 m interval as bona fide, the Spearman Correlation Coeficient is calculated with the data for the interval included and with it excluded.

When descriptive statistics and graphics are applied to density data from the 14 distance intervals, the 300 m density figures are extreme outliers for several density measures (tables 17, 18, figure 22). An explanation may be the size of the surveyed area for this interval, which is the smallest of the 14 intervals with survey data. This is reason enough to consider excluding the 300 m density data from further analysis.

When the Spearman Rank Order Correlation Coefficients are calculated for ARCHDENS and DISTANCE FROM FRESHWATER, it makes little difference whether the 300 m and 1000 m interval data are included or excluded, demonstrating the strength of the underlying pattern (table 19). With both intervals included (14 data points) there is a –0.74 correlation; with both excluded the correlation is –0.87. In both cases, the critical 0.05 significance value is far exceeded (table 19).

A computer-generated trend line on the XY plot of ARCHDENS and DISTANCE FROM FRESHWATER illustrates the generally linear nature of this relationship (figure 23a). However, the true relationship between the two variables is not linear, but still clearly an inverse one as suggested by the curve in figure 23b. ARCHDENS is highest within 250 m of freshwater and decreases markedly between 250 m and 350 m to reach a consistently low level from 350 m to 850 m distance.

To conclude:

> *Archaeological density tends to decrease as distance from permanent freshwater increases. Densities are highest within 250 m of water and fall to low levels beyond 350 m distance.*

Figure 22. Box and Whiskers Plots and Histograms for Density Variable Values Used in the Distance from Freshwater Analysis (fourteen intervals/data points) (Kwikstat Version 4, Elliot 1994): a. SITEDENS; b. ARTDENS; c. SITEAREA%; d. ARCHDENS.

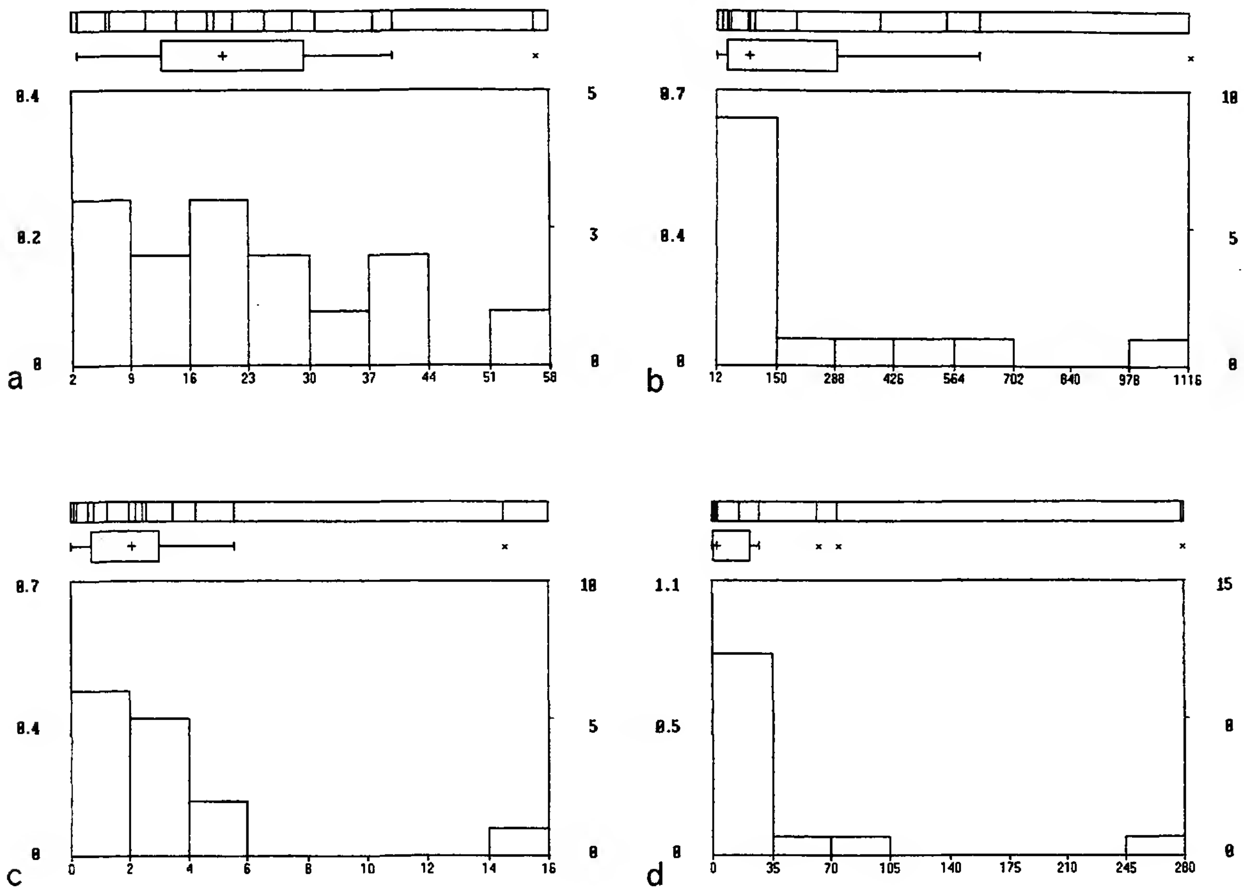


Table 18. Descriptive Statistics for Density Variable Values Used in the Distance from Freshwater Analysis.

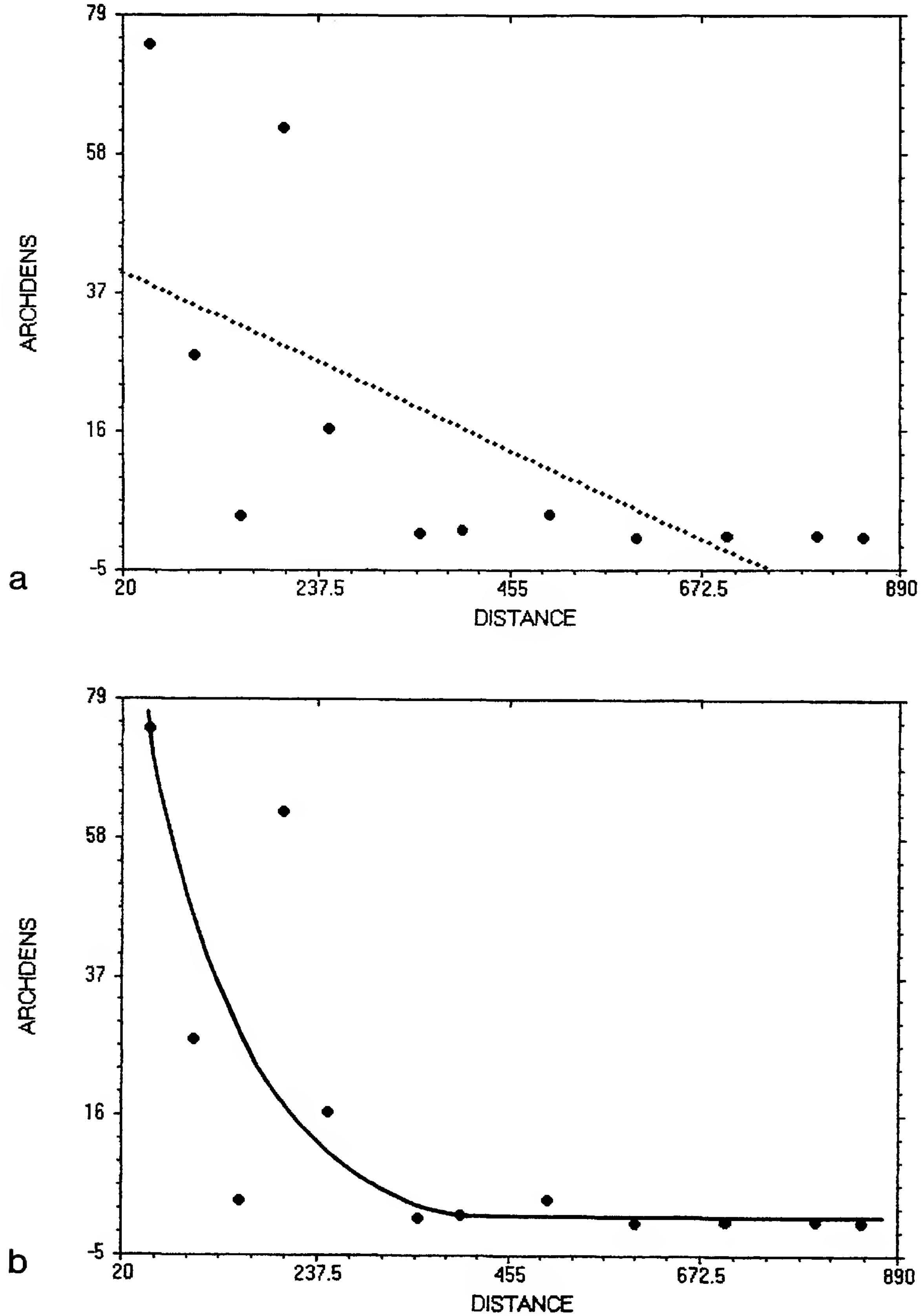
Variable	n	Mean	Med	Min	Max	SD	Sem	Var	CVar	Norm
SITEDENS	14	22.70	20.18	2.67	56.25	14.43	4.00	224.33	0.66	no
ARTDENS	14	237.30	87.52	12.00	1115.14	312.08	86.55	104883.00	1.37	no
SITEAREA%	14	2.87	2.12	0.01	14.51	3.60	1.00	13.98	1.30	no
ARCHDENS	14	33.54	2.68	0.01	278.53	71.86	19.93	5560.52	2.22	no

Note: Density variables are defined on page 46.

Table 19. Spearman Rank Order Correlation Coefficients for Variables ARCHDENS and DISTANCE FROM FRESHWATER (Elliot 1994; Mendenhall et al. 1989: Appendix table 10).

Variables	n	Correlation Coefficient	Critical Value (0.05)
ARCHDENS, DISTANCE FROM FRESHWATER	14	–0.74	–0.457
ARCHDENS, DISTANCE FROM FRESHWATER	12	–0.87	–0.497

Figure 23. XY Plots of Archaeological Density vs. Distance from Freshwater (Twelve Intervals/ Data Points) (Kwikstat Version 4, Elliot 1994): a. with computer generated linear trend line; b. with curve.



Landform Element

The relationship between the density of archaeological remains and landform element is considered next. Table 20 presents density estimates calculated for all sample units belonging to specific landform element types within the study area (table 3). Much of the surveyed area is located on ridges, hills and mountains. It follows that the four landform elements relating to ridges, hills and mountains, namely 'crest,' 'upper slope,' 'mid-slope' and 'lower slope,' comprise the bulk of the surveyed sample.

There is a clear association between archaeological density and certain landform elements on hills or mountains. This relationship appears to hold despite location within the study area or the general density of archaeological remains in a given area and can be stated as follows:

> *Archaeological densities on hills or mountains in the Otway Range are highest on crests and decrease downslope to valley flats or floodplains, which have the lowest densities.*

No sites were found in valley flats. A low archaeological density is probably present, but the small sample size and likely burial of sites by alluvial and colluvial sediments made the discovery of sites unlikely during the Otway Survey.

A low archaeological density is apparent for floodplains; however, it is really not possible to state with confidence what the actual situation is on floodplains. It is understood that sites have been buried by overbank deposits, but most late Holocene sites should be exposed by the 20–30 cm deep ploughing on many sample units. On the other hand, the rapidity and depth of floodplain deposition is unknown and in consideration of the massive 19th century vegetation clearance and its effects on upslope soil erosion, perhaps many sites only a few hundred years old on floodplains are deeply buried. Therefore, a low archaeological density is accepted for floodplains, although the figure in table 20 probably underestimates the actual density.

Surveyed plains occur near the coast, as do virtually all plains in the study area (not including floodplains). For several measures of archaeological density, plains have the highest figures of any landform element.

Table 20. Density Variable Values for Surveyed Landform Elements.

Landform Element	Area Surveyed (m^2)	SITEDENS	ARTDENS	SITEAREA%	ARCHDENS
Shoreline (SHL)	2,510,350	40.64	25.90	3.08	3.21
Crest (CST)	833,025	55.20	1010.40	4.09	228.12
Upper Slope (USL)	1,375,150	15.27	122.86	0.57	1.07
Mid Slope (MSL)	1,223,400	12.20	67.10	1.64	1.34
Lower Slope (LSL)	720,450	11.12	98.69	0.025	0.027
Valley Flat (VFL)	37,700	0.00	0.00	0.00	0.00
Floodplain (FLP)	1,086,960	4.60	15.64	1.85	0.13
Plain (PLN)	399,850	20.00	1760.00	8.30	292.16
Dune (DNE)	3,070	977.19	8468.98	4.20	34,758.37
Scarp (SCA)	750,000	9.31	6.65	6.96	0.43
River Terrace (RTR)	76,300	13.11	13.11	.0013	.0002

Note: Density variables are defined on page 46.

Native Floristic Communities

Only Otway Survey sample units were considered when examining the relationships between archaeological density and native floristic communities. This is because other archaeological surveys were predominantly located along the coast and in other areas for which there were no appropriate vegetation distribution maps (Brinkman and Farrell 1990). Sample units were surveyed in seven major floristic communities (table 21). In cases where sample units encompassed more than one floristic community, it is attributed to the dominant community in the sample unit.

Damp sclerophyll forest has the highest density of archaeological remains. This is not surprising, given that this floristic community predominates around the peripheries of the upland and the previously demonstrated high archaeological densities in these areas both north and south of the Otway Range. The floristic community exhibiting the next most dense archaeological remains is the wet heath community, found in low-lying areas along the coast and inland. Wet sclerophyll forest, the characteristic floristic community of the upland core of the study area, has the third highest density of archaeological remains.

Table 21. Density Variable Values for Surveyed Floristic Communities (Brinkman and Farrell 1990:25–31) (Otway Survey Data Only).

Landform Element	Area Surveyed (m^2)	SITEDENS	ARTDENS	SITEAREA%	ARCHDENS
Coastal Complex	1200	0.00	0.00	0.00	0.00
Heathy Woodland	69,100	72.35	101.30	0.064	0.47
Foothill Forest	358,100	22.34	89.36	0.49	0.99
Damp Sclerphyll Forest	78,200	89.51	1342.71	6.38	766.79
Riparian Damp Sclerphyll Forest	144,100	0.00	0.00	0.00	0.00
Riparian Scrub	28,600	0.00	0.00	0.00	0.00
Wet Sclerphyll Forest	1,149,000	32.20	209.75	1.27	8.58
Wet Heath	26,200	114.50	496.18	1.84	104.54

Note: Density variables are defined on page 46.

Discussion

The factors influencing site location are, in decreasing importance, proximity to an ecotone, proximity to freshwater, flatness of ground and low elevation. Late precontact period Aboriginal occupation of the Otway Range appears to have been concentrated on narrow strips along the peripheries of the Range. The central core of the range, including the upper slopes and the plateau, was also visited and exploited by Aboriginal populations, but on a much lesser scale than the ecotonal peripheries.

Predictive Model

Results of the above analysis cannot be directly translated into a predictive model of archaeological surface site distribution and density. Results of surveys have been taken at face value to this point and there has been little integration of factors that may have produced distorted values regarding site contents, density and size. This was deliberately done because the effects of various identified 'distorting' factors can only be estimated given our current state of knowledge. However, now, with the basic analyses completed and as a prelude to model-building, it is appropriate to estimate and correct for such factors.

Artefact Collectors

The largest distorting factor affecting the contents of artefact scatter sites is the collection of artefacts by amateurs. Such collectors usually pick up obvious or large items, such as axes and grinding stones, although quantities of flaked stone have also been removed from sites (du Cros 1990: table 4; Head and Stuart 1980; Presland 1982: appendix 2). The absence of ground axes at sites discovered during the Otway Survey and their abundance in private collections provenanced to the Otway Range leads to the conclusion that entire sites consisting of such implements have been completely collected and/or these items have been removed from sites that also have flaked stone artefacts. It is also likely that several sites consisting of flaked stone artefacts have also been completely collected.

It is apparent from information on private collections originating in the Otway Range held in the Museum of Victoria (du Cros 1990:table 5) that most of the collected ground stone items come from the coast or close to it (i.e. within 5–6 km). This observation was supported by the discovery of two more private artefact collections during the Otway Survey. One originated from sites approximately 5 km from the ocean and contained over 20 ground stone items, while the other, from a location approximately 15 km from the ocean, contained only two, despite the keenness of the collectors.

In conclusion, it is likely that sites consisting solely of ground stone artefacts or chipped stone tools and complete ground stone artefacts will be found in the study area, particularly within approximately 5 km of the coast. These will generally only be discovered as they are exposed by clearing, logging and ploughing.

Artefact Frequency Distortion on Artefact Scatter Sites

Almost all the Otway Survey sample units are on land that has been disturbed by ploughing, clearing or track construction. While there is no available objective means for estimating the effects of clearing or track construction on surface artefact density, there have been experimental studies that have investigated the effects of ploughing on the percentage of artefacts actually present in the ploughzone vs. those that appear on the surface after tillage (Lewarch and O'Brien 1981; Clark and Schofield 1991). These studies have demonstrated that only approximately 3–10 per cent of the artefacts present in a ploughzone are exposed on the surface after a ploughing event.

Some sample units had only been subjected to short-term tillage as in the experiments, while others had been subjected to tillage over a much longer period. Differences between short -and long-term tillage effects are not known, however they are assumed to be similar for the purposes of this study. Therefore, it can be reasonably expected that surface artefacts on sites located on ploughed fields represent only between 3 per cent and 10 per cent of the total number of artefacts in the ploughzone. However, since the predictive model is for surface manifestations of the archaeological record only, this information is something the reader should keep in mind, but it is not used to adjust the raw artefact density figures.

Size Distortion of Shell Middens

The surface area of individual shell middens along the coast of the study area is difficult to estimate. There are several reasons for this. First, in one previous survey, midden length and width were not consistently recorded, and only length was recorded in another. There is, therefore, not much actual data to use to determine the range of midden size and for proposing a basis for estimating size from length alone or simply an average size to apply

to middens with no size estimates. Second, the extent of a midden is difficult to estimate because most are buried by sand and have only small exposed areas in cutbanks or blowouts. The measurements reported in chapter 4 most probably consistently underestimate the true size of middens. A correction has already been made for the Apollo Bay to Lorne site sample which had only length recorded. It was decided to employ a conservative estimate with shell midden area calculated as observed length multiplied by 0.5 observed length.

Discussion

Considering the above information, there is likely to be a higher site density than indicated in the raw calculations based on the survey results. Therefore, these numbers have been rounded slightly upwards. Site area has also been rounded slightly upwards from the raw figures.

Sensitivity Zones

Three zones of Aboriginal archaeological sensitivity are defined, each characterised by a distinct surface site density, artefact density, area occupied by sites, size range of sites and variety and frequency of site types (table 22, figure 24). Predictive statements on the characteristics of the archaeological record expected to be found in each sensitivity zone are provided below.

Sensitivity Zone 1: Southern Periphery of the Otway Range

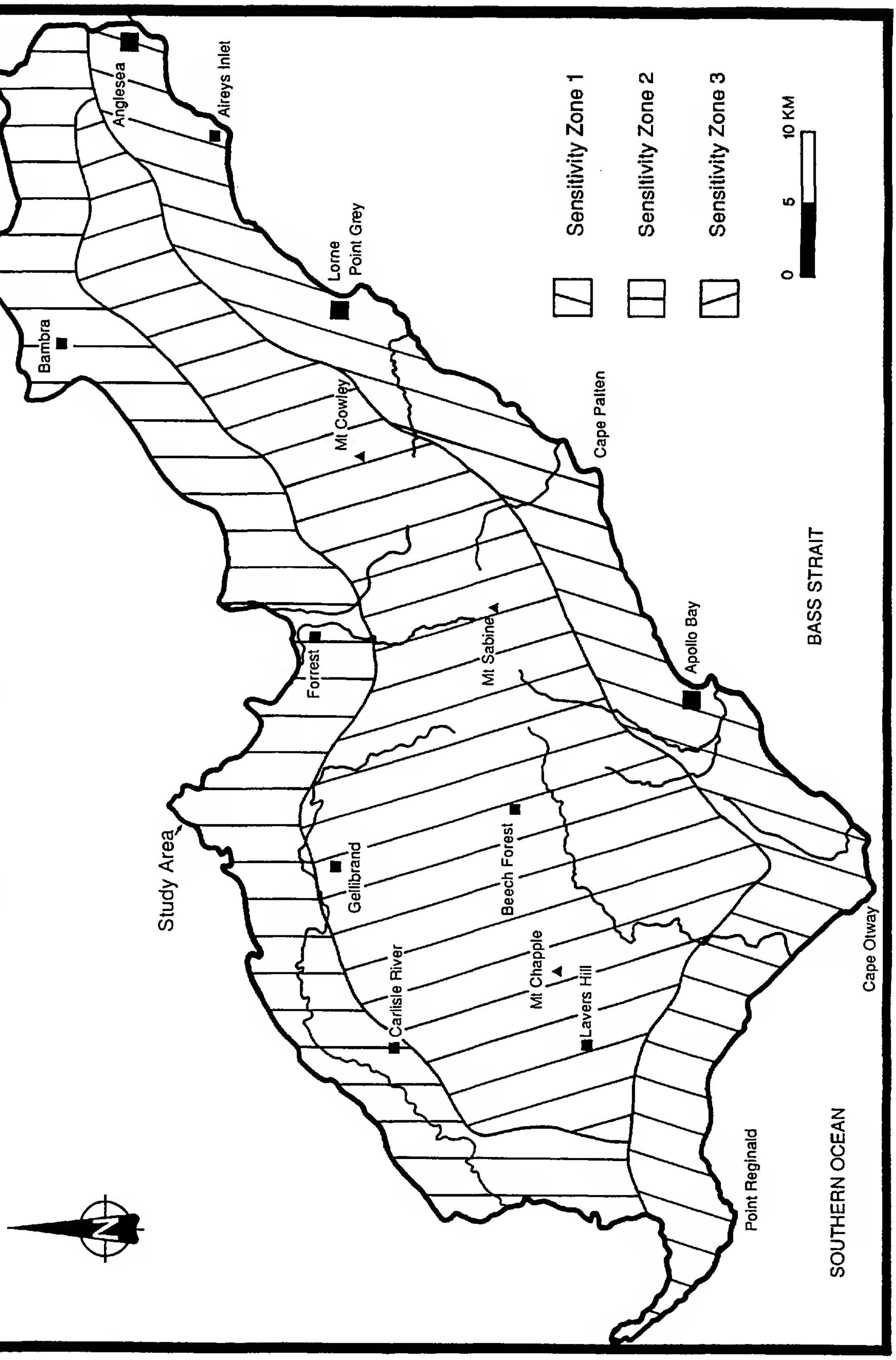
Sensitivity Zone 1 is considered to have the highest archaeological sensitivity of the three zones (table 22). It extends along the entire coastline from the high-water mark to 5 km inland (figure 24). A variety of terrains are present in Zone 1: sandy beaches, rock platforms and steep cliffs along the shoreline, and coastal plains with sand dunes that extend several kilometres inland in a few locations. In many places, the foothills of the Otway Range extend down to the ocean. Marine shell middens and artefact scatters are the predicted predominant site types expected in this zone, although other types of site will be present in small numbers.

Shell midden sites can generally be expected to be found from just above the high-water mark to about 500 m inland, although in areas of coastal plain they may occur at distances of over 2 km inland. Shell midden sites will have areas of up to 50,000 m^2, although most will be considerably smaller. The vast majority will be open sites, but some will be located within rockshelters. Portions of middens will be exposed in blowouts as shell scatters, sometimes associated with stone artefacts, charcoal and manuports, or in sections (e.g. road cuttings, clifflines, riverbanks, etc.) as one or more thin (2–3 cm) to very thick (20–30 cm or more) layers of shell, often occuring in a dark charcoal-rich or greyish ashy matrix.

The contents of shell middens will be mostly marine shellfish shell, especially *Subninella undulata* and *Brachidontes rostratus*, although some will also contain fish, sea mammal, terrestrial mammal and bird bones. Flaked stone tools and debitage, ground stone artefacts (including axes) and heat retainers may be present. Expected associated features include hearths, pits and possibly hut depressions.

Artefact scatter sites are expected to occur in high densities from about 100 m from the shoreline to over 4 km inland. They will usually consist of flaked stone tools and debitage and will sometimes also include stone axes, grinding stones and heat retainers. The most common raw materials of flaked stone artefacts will be silcrete, quartz and flint. Surface artefact numbers can be expected to generally range from 1–175, and surface area from

Figure 24. Archaeological Sensitivity Zones in the Otway Study Area.



1–14,000 m^2. Most of these sites will be shallowly buried, their exposure on the ground surface caused by wind or water erosion, or more usually, by recent human activities.

Expected Aboriginal archaeological surface densities within Zone 1 are very high, averaging 30 sites/km^2 and 150 artefacts/km^2. Archaeological sites are predicted to occupy 4 per cent of the surface area of Zone 1. Artefact scatter sites are predicted to be predominantly located on coastal plains and the crests of hills and ridges rather than slopes, valley flats and floodplains. Shell midden sites are predicted to be concentrated along the shoreline, but their distribution will extend further inland where broad coastal plains occur.

Sensitivity Zone 2: Northern Periphery of the Otway Range

This zone consists of a 5 km wide strip along the north, north-west and north-east periphery of the Otway Range (figure 24). It encompasses the low foothills and the beginning of the steeper slopes of the Range, as well as several large floodplains. It is predicted that most sites will be artefact scatters with flaked stone artefacts predominantly made of silcrete and quartz, although small amounts of quartzite, chert, chalcedony and coastal flint will also sometimes be present. It is expected that ground stone tools will also sometimes be found at these scatters, or occasionally on their own. Artefact scatters in Zone 2 can be expected to range in surface area from 1–4000 m^2 and contain from 1–75 surface artefacts (table 22). Small numbers of other site types will also be present.

The expected Aboriginal archaeological surface density in Zone 2 is 25 sites/km^2 and 200 artefacts/km^2. Archaeological sites are predicted to occupy 1 per cent of the surface area of this zone, with the highest densities predicted to occur on the crests of ridges and hills.

Sensitivity Zone 3: Interior of the Otway Range

This zone consists of the uplands of the Otway Range (figure 24). Artefact scatter sites are the predicted predominant site type, although small numbers of other types will also be present. Artefact scatters are expected to range from 1–200 m^2 in surface area and contain up to ten surface artefacts. These will be mainly be comprised of flaked stone artefacts made on silcrete or quartz, although ground stone artefacts may occasionally be present.

Aboriginal archaeological surface density is predicted to be consistently low throughout Sensitivity Zone 3, with 20 sites/km^2 and 50 artefacts/km^2 expected. Sites are predicted to occupy less than 1 per cent of the surface area of this zone, with the highest archaeological densities expected along the tops of ridges.

Table 22. Otway Study Area Archaeological Sensitivity Zone Density Summary.

Sensitivity Zone	SITEDENS	ARTDENS	SITEAREA%	ARCHDENS
1	30	150	4	18
2	25	200	1	5
3	20	50	<1	1

5. Aboriginal Settlement Patterns in the Otway Range

Introduction

Much of this report has dealt with the distribution of archaeological sites in the Otway Study Area and the relationships between sites and environmental features. These subjects are of interest to archaeologists and of even greater interest to cultural heritage managers. Archaeology, however, has larger concerns, one of which is studying the nature of precontact Aboriginal settlement patterns as an avenue to understanding past Aboriginal cultures, their history and how and why they changed. It is the duty of archaeologists to address such concerns, in addition to meeting the cultural heritage management goals of a project, because it is only through the exploration of such matters that more knowledge can be gained regarding the precontact period. Further, a comprehensive understanding of the precontact period in a region must improve the ability of cultural heritage managers to manage Aboriginal sites effectively. While it is far beyond the scope of the present study to delve deeply into the archaeology of the study area through, for example, detailed analysis of artefacts from previously excavated sites, late precontact period settlement models are offered with the hope that future researchers will attempt to test and develop them further.

Witter (n.d.) argues that most sites presently known in the Apollo Bay area belong to the Late Prehistoric period (ca. 5000–200 BP). This is the case throughout the Otway region, with few late Pleistocene or early Holocene sites known. The few that have been identified have been excluded from the sample used in this study. Therefore, the site distribution patterns discussed in previous chapters and in the settlement models presented below are attributed to the Late Prehistoric period.

Evaluation of Previous Models

It is of interest to evaluate how the pattern of site distribution in the Otway Range, discussed in chapter 4, supports Aboriginal settlement pattern models previously proposed by Lourandos, Stuart and Witter (chapter 2, figures 5–9).

Lourandos asserts that Aboriginal settlement in the Otways would have been 'tightly coastal' (Lourandos 1980:296). 'Tightly coastal' is an expression open to interpretation; however, the very high density of sites within 5 km of the coast and very low density of sites beyond, generally does support his model. He also stated that summer residential sites will be located on the coast. The available evidence supports this spatial pattern, although the season of occupation is not known for most sites. Lourandos also suggests that fall–winter residential sites will be located in sheltered bays and estuaries not far from the coast, with some resource extraction locations located along the coast. Again, the postulated spatial patterning is not contradicted by the site distribution evidence, and again the seasonal aspect cannot be evaluated.

Stuart's (1979) model is similar to that of Lourandos, although phrased differently and mainly restricted to the Aire basin. The spatial patterning of site distribution suggested by this model, which implies that most residential sites will be near the coast, is also not contradicted by the Otway Survey data.

Witter's (n.d.) Microblade period summer–spring settlement pattern has residential sites located near the coast and resource extraction locations located on the coast and a short distance inland. His model is similar to that of Lourandos, although it differs in the degree of residential mobility suggested. Nevertheless, it is not contradicted by the survey data. Witter has a major fall–winter population movement from the coast to inland locations, one of

which may be the Barwon River valley. This assertion is partially supported by the survey evidence, but cannot be fully evaluated since some of his postulated wintering areas are outside the Otway Study Area.

Witter's Post-Microblade period summer–spring settlement pattern involves residential sites and locations on the coast, a pattern that is not contradicted by site distributions. In winter–fall, he has residential sites located on the lower slopes of the range, with locations on the slopes of the range and on the coast. This pattern is difficult to evaluate because it is not clear what is meant by 'lower slopes' of the Otway Range. It could easily mean distances only 1 km from the coast in many areas. Alternatively, the lower slopes generally extend 2, 3, 4 or even 5 km from the coast. If distances of 4–5 km are suggested, and this seems to be what Witter is implying (Witter n.d.:figure 50), then this aspect of his Post-Microblade period model is not supported by the survey data. If he means distances of up to 3 km, then the survey data support his model.

All of the previous models are general in nature or require the investigation and analysis of many sites to test their implications. Therefore, the simple test of comparing some of the implications of these models with the site distribution data can only refute certain aspects of these models; other general aspects are not contradicted by the evidence, but it must be stressed that this does not confirm them. An almost infinite variety of settlement-subsistence models could be postulated to fit the distribution of sites as presently known in the Otway Region, although some are much more likely than others to represent reality.

New Settlement Pattern Models

When patterning became apparent in the Otway Survey data (chapter 4), the author was struck by the implications for late precontact period Aboriginal land use and settlement patterns. The pattern of site distribution, briefly, is that sites are concentrated along the ecotonal peripheries of the Otway Range, with much lower site densities throughout the inner portions of the Range. The inner Range artefact scatter sites are consistently small, contain few items and are tentatively considered 'low bulk extraction locations' (Binford 1980:343) rather than residential bases or field camps. In contrast, the peripheral Range areas include larger lithic scatter sites that contain higher numbers of items and a greater diversity of material classes, occasionally including heat retainers (at a few coastal-peripheral sites). These sites probably represent residential bases and field camps, while locations are also represented in these areas by small, sparse artefact scatter sites. In addition, several very large shell middens on or near the coast containing diverse assemblages probably also represent residential sites. Many lesser shell middens, which commonly have few or no lithic items visible on the surface, are probably specialised and very visible 'high bulk' marine resource extraction locations rather than residential sites.

The models are descriptions of settlement patterns of societies with economic organisations that are essentially those of 'foragers' (Binford 1980). They are therefore based on the assumption that most economic activity occurs while people make day-trips from residential bases to hunt or collect food and other resources within a typical 10 km foraging radius (Jarman 1972). Lack of evidence of food storage argues against a logistical organisation. It is entirely possible however, that specialised task groups made extended trips to obtain certain resources such as seals, which are typically restricted in availability both spatially and temporally. Nevertheless, the latter would not alter the basic foraging nature of the economy.

The models presented below are, admittedly, simple approximations of how Aboriginal people may have used the Otway landscape in the recent precontact past. For example, the ideological aspects of culture are ignored in the

models due to the paucity of pertinent archaeological information. Nor are such details as group size and composition considered, for similar reasons. The models should thus be regarded as points of departure for future research, rather than as ends in themselves.

Previous archaeological, ethnohistoric and floral and faunal distribution studies contain information on food resources that could have been exploited by precontact Aboriginal populations in the Otway Study Area (Brinkman and Farrell 1990; Chadzynski 1981; du Cros 1990; Fullagar 1982; Head and Stuart 1980; Lourandos 1980; Scarlett 1977; Witter n.d.). In addition, there is information on the faunal remains found at excavated sites (Fullagar 1982; Lourandos 1980; Zobel 1982) and on shellfish collected from several middens (Witter n.d.). This information is used to present a general consideration of food resource availability below. It must be remembered that the purpose of the models is to postulate settlement patterns for the study area and not to attempt a detailed reconstruction of the precontact economy.

The southern periphery of the Otway Range is resource-rich, offering diverse sources of food: small to medium terrestrial mammals such as wallabies, pademelons and possums; a variety of edible terrestrial plants; freshwater wetlands with edible plants, fish, and birds; creeks and rivers with fish, eels and freshwater shellfish; and marine resources including shellfish, crustaceans, fish and seals. The inner Otway Range forests have much less food resource diversity but still offer some terrestrial plants and mammals, bird species and fish. The northern periphery of the Otway Range offers access to the same medium and small mammals as the southern periphery, but with the important addition of kangaroo and emu. A variety of grassland, woodland and forest plant species are available, as are fish in creeks and rivers, and plants, fish and birds in wetlands. Food resource availability is not so markedly seasonal that entire areas would be unsuitable for Aboriginal occupation at any time of year. Weather alone makes the coast less attractive in winter than at other times of year.

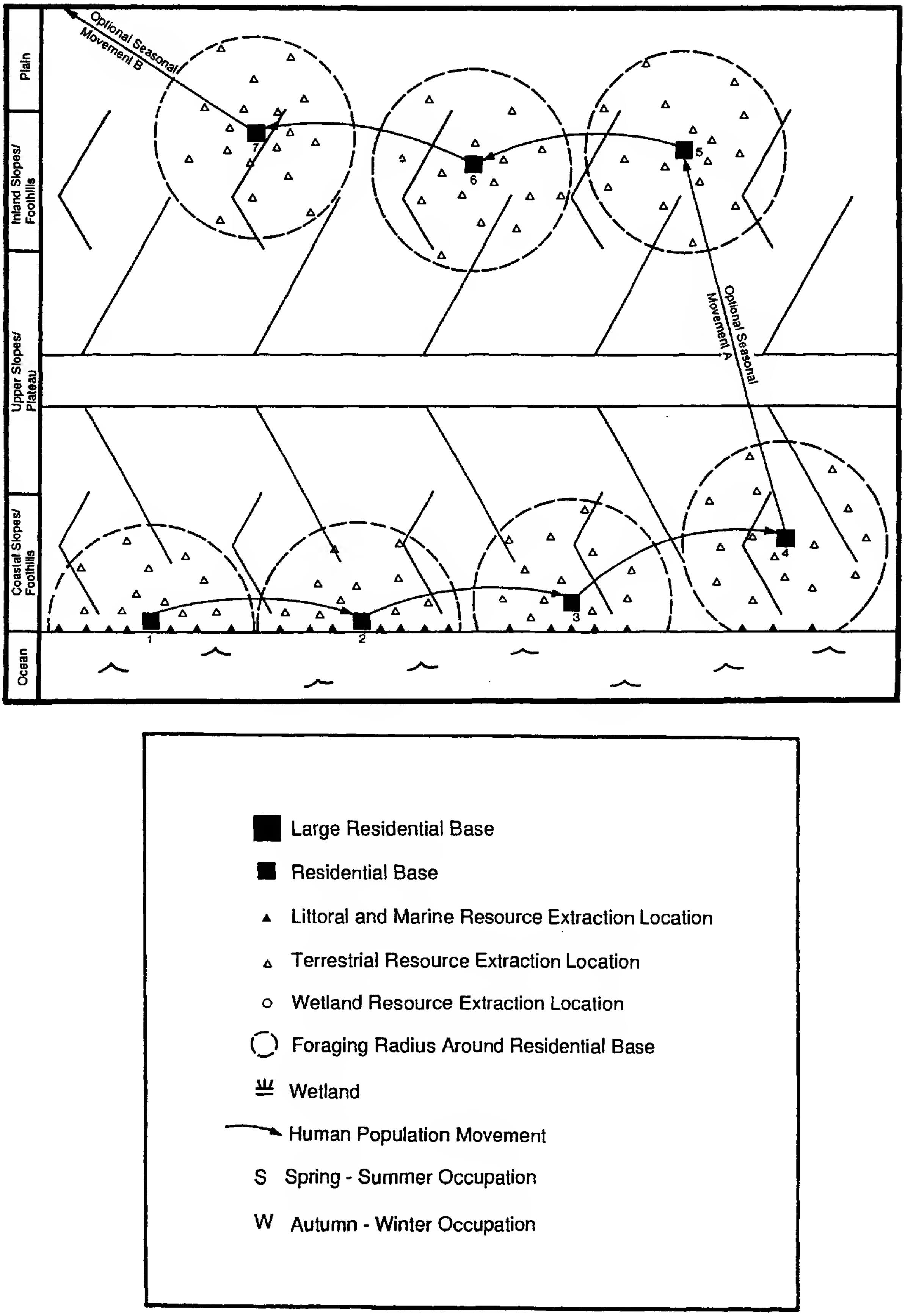
Technologically important resources are available in the Otway Range. Materials for making flaked stone tools are differentially distributed. Quartz is ubiquitous throughout the Otway region and silcrete only somewhat less so, while flint is present only at certain locations along the coast (Scott-Virtue 1982). Sandstone for grinding implements is also widely available. Two large sandstone boulders with axe grinding grooves were reported to the east of Gellibrand (Massola 1962). There would have been once plentiful and varied wood and bark sources in the forests for technological purposes; the large numbers of axes in private and museum collections attest to their exploitation.

Model 1

The coastal peripheral area was occupied year-round, with residential moves parallel to the coast (figure 25:1–4). A 10 km foraging radius would include substantial areas of littoral, coastal scrubland/plain and lower Otway slopes. Many small to medium shell middens may represent littoral and marine resource extraction locations and, occasionally, field camps/locations. A relatively high density of small artefact scatter sites throughout this area reflects locations where terrestrial resources were obtained and possibly field processed. A low density of artefact scatters in the inner Range represents the infrequent use of this area for terrestrial resource extraction, possibly mainly for technological plant species.

Two types of probable residential sites are apparent. Large shell middens with diverse contents are one type and medium to large artefact scatters, also with diverse contents, are the other. Shell middens are located on or close to the coast (figure 25:1, 2), while the large artefact scatters tend to be located up to a maximum of about 5 km

Figure 25. A New Aboriginal Settlement Pattern Model For the Otway Study Area.



from the coast (figure 25:3–4). Assuming some contemporaneity between these two types of site, an assumption partially supported by microlithic tools being found at both types, they may represent differing seasonal patterns of occupation.

The northern peripheral area with high site density results from two likely sources, both unrelated to the settlement system evident on the southern edge of the Otway Range. It is possible, but not very likely, that a permanent population occupied this periphery. If this was the case, the site distribution would again suggest a residential base movement parallel to the edge of the Range (figure 25:5–7). Residential sites may well have been located approximately 1–3 km within the Ranges so that a 10 km foraging radius would include ecotonal foothill-woodland/plain-grassland resources and forest resources. The other possibility is that the above described pattern is only one seasonal component in a system that includes other heavily exploited areas, possibly around Lakes Colac and Corangamite and the Barwon River valley (figure 25:Seasonal Movement B).

Model 2

Occupation of the coastal peripheral area on the southern edge of the Otway Range represents one seasonal component of an Aboriginal settlement/economic system that included a move to the northern periphery of the Range (figure 25:Seasonal Movement A). In this scenario, the variability in coastal residential sites may still be seasonal but may represent fine-grained seasonal differences rather than a simple spring–summer vs. fall–winter dichotomy. Otherwise, the coastal foraging pattern would be similar to that of Model 1. Similarly, the pattern described in Model 1 for populations with residential camps just inside the northern foothills of the Range would be the same for this model. Again, it is possible that at least one other seasonal move to a distinct environmental zone may be involved (figure 25:Seasonal Movement B). The system could well have included seasonal visits to environmentally diverse areas such as the southern Otway coast, the northern Otway foothill-woodland/plain-grassland ecotone to the north, and lakes and rivers on the volcanic plain-grassland (e.g. Lakes Colac and Corangamite, Barwon River).

While the above models are intended to characterise late precontact period (ca. 5000–150 BP) Aboriginal settlement patterns, neither can be attributed to the Microblade or Post-Microblade periods (Witter n.d.). It should be noted that there is not necessarily any difference in settlement/economic systems between these periods, defined as they are on the basis of changes in lithic technology, which is not always an indicator of major changes in the subsistence economy or settlement system. There may well be more substantial changes in settlement/economy within each of these periods than between them. It is also possible that each of the above models may approximate the settlement movements and land-use of contemporaneous Aboriginal groups occupying different parts of the Otway Range. Another possibility is that Model 1 generally approximates the settlement pattern of Aboriginal populations, except under certain circumstances of resource stress, when a pattern more like Model 2 was adopted.

6. Aboriginal Cultural Heritage Management

Introduction

This chapter provides recommendations for the management of archaeological sites within the Otway Study Area. The predictive model presented in chapter 4 is a cultural heritage management tool and this chapter focuses on how that tool can be used to minimise the disturbance or destruction of Aboriginal archaeological sites. The predictive model discusses which areas or landforms within the study area are likely to contain sites and, therefore, have archaeological importance. Another way of discussing archaeological importance is to evaluate the significance of individual sites. Significance has a special meaning in this context and the significance of archaeological sites in the study area is discussed below.

Significance

At the completion of the Otway Survey there was a total of 276 recorded Aboriginal archaeological sites that fell into nine site types (appendix, table 23). Somehow, these sites have to be ranked in order of significance so that efforts to preserve or mitigate sites can be directed to those most worthy of attention. Evaluating the significance of archaeological sites within a region is one of the most difficult tasks facing archaeologists and cultural heritage management planners. The significance of a site can be based on many factors, such as educational, Aboriginal, archaeological and tourism values. Aboriginal significance should only be assessed by Aboriginal people, while educational and tourism values are ultimately tied to the Aboriginal and archaeological values of a site. Archaeological (or scientific) significance is considered here. Archaeological significance refers to the potential of a site to address archaeological research questions (Bowdler 1981, 1984).

It should be recognised that the significance of specific sites will change with increased archaeological knowledge of an area as archaeologists seek answers to more sophisticated questions. An important aspect of archaeological significance is the rarity of certain site types within a region. The rarity value of a site type could change as some sites are destroyed by development or natural processes, or as future surveys result in perceived changes in the regional proportions of site types.

Table 23. Distribution of Aboriginal Archaeological Site Types by Sensitivity Zone.

Site Type	Sensitivity Zone		
	1	2	3
Shell Midden (SM)	166	0	0
Artefact Scatter (AS)	40	9	6
Isolated Find (IF)	14	8	12
Rock Shelter (RS)	8*	0	0
Human Burial (HB)	2*	0	1*
Lithic Quarry (LQ)	1*	0	0
Grinding Grooves (GG)	0	0	1*
Earth Mound (MD)	0	0	1*
Fish Trap (FT)	1*	0	0
Collection (CO)	1	1	1
Non-Site (NS)	2	0	1
TOTALS	235	18	23

* Rare site type in Zone.

Archaeological significance is evaluated on the basis of four surface attributes of each site and a site type attribute (rarity). A site type is considered rare if it is represented by less than 5 per cent of the sites in a Sensitivity Zone (table 23). Site attributes size, number of chipped artefacts on surface, diversity of contents, and condition (degree of intactness) are scored on three-point scales as indicated in table 24. If a site belongs to a rare type (table 23), it is automatically awarded a score of nine, plus whatever points are appropriate to its condition. The other three site-specific attributes do not enter into the assessment of sites belonging to rare types. If a site does not belong to a rare type, it is scored solely on the basis of its surface attributes. This has the effect of giving sites belonging to rare types high ratings without devaluing other sites simply for belonging to commonly represented types.

Each site can have a potential significance rating score of between four (lowest) and 12 (highest). Sites with very incomplete records, artefact collections and non-sites (deregistered sites) are not scored or rated. Sites with a significance rating score of 9–12 points are of high archaeological significance, sites with a score of 5–8 points are of moderate significance, and sites with a score of four points or less are of low significance. Known sites in the study area have been assessed using this system (appendix A) and the significance rating results are summarised in table 25. When new sites are discovered in the study area they can be easily scored according to the criteria in tables 23 and 24 given a significance rating. If major new surveys substantially alter the proportions of site types in a zone, then the perception of what constitutes a rare site type may change.

Many characteristics of the Otway Study Area's site distribution pattern and related settlement pattern models indicate that each sensitivity zone represents distinct and different aspects of the region's precontact past. For this reason, site significance is considered separately for each sensitivity zone. Therefore, while a highly significant site in Sensitivity Zone 1 is equivalent in terms of archaeological importance to highly significant sites in Sensitivity Zones 2 or 3, the criteria for scoring attributes are somewhat different in each zone (table 24).

Table 24. Otway Study Area Archaeological Significance Rating Scoring System.

Site Attributes	Sensitivity Zone			Significance
	1	2	3	Rating Score
Condition	poor	poor	poor	1
	fair	fair	fair	2
	good	good	good	3
Size	1–99	1–9	1–9	1
(Surface Area in m^2)	100–999	10–99	10–49	2
	>999	>99	>49	3
Number of Chipped	0–1	0–1	0–1	1
Stone Artefacts	2–5	2–5	2–5	2
on Surface	>5	>5	>5	3
Diversity of Contents	0–1	0–1	0–1	1
(Number of Material Classes)	2	2	2	2
	>2	>2	>2	3

Table 25. Otway Study Area Aboriginal Archaeological Site Significance Rating Summary.

Sensitivity Zone	Low	Moderate	High	Unrated	Total Sites
	Archeological Significance				
1	13	170	47	5	235
	5.50%	72.30%	20.20%	2.10%	100%
2	2	10	5	1	18
	11.10%	55.50%	27.80%	5.60%	100%
3	4	10	7	2	23
	17.40%	43.50%	30.40%	8.70%	100%
Total Sites	19	190	60	7	276
	6.90%	68.80%	21.70%	2.50%	100%

In this scheme, all intact archaeological sites have a significance rating of moderate of higher. It is generally only severely disturbed sites that have a low significance rating and are regarded as having little potential to contribute to the prehistory of the study area. While there is no reason to expend limited resources protecting or investigating those sites when threatened by destruction, their location and surface characteristics should be recorded in as much detail as possible. Sites of moderate significance are usually small to medium in size, with low to moderate numbers of artefacts and diversity of contents; they have the potential to contribute to the understanding of prehistory. Moderately significant sites should be protected from destruction and when this is not possible a representative portion should be investigated before disturbance. Highly significant sites are usually rare types, exceptionally large sites, or sites with a high diversity of material contents that are largely intact. These sites must be protected from destruction. If this is not possible, they must be thoroughly investigated before disturbance takes place.

Shovel Test Sampling

It is the author's opinion that shovel test sampling is well suited for discovering shallowly buried sites in areas of very low surface visibility. This method should be employed in cultural heritage management situations, particularly where areas with low surface visibility must be assessed before disturbance. For example, a shovel test sampling program could be applied to a proposed logging coupe that has the potential to contain archaeological sites. The result of a properly applied shovel test sampling survey would be a clear picture of the number and location of archaeological sites in the proposed coupe. Most importantly, these sites would be intact, except for relatively small disturbances from the shovel test sampling pits. This is an option far superior to waiting for disturbance to occur before examining coupes for sites. If the effects of logging are to be mitigated by the excavation of significant sites, undisturbed sites have a vastly greater amount of information to contribute than disturbed sites. If significant sites are to be protected from the effects of logging, they are much more worth protecting if they are intact.

Management Recommendations

This section provides recommendations of a general nature on how to best manage the Aboriginal archaeological sites of the study area. The recommendations should provide useful guidelines for Aboriginal communities, local and state government planners and AAV for helping to avoid or minimise development impacts on archaeological sites. It should be noted that Aboriginal archaeological sites are afforded statutory protection under the (Commonwealth) *Aboriginal and Torres Strait Islander Heritage Protection Act* 1984 and the (Victorian) *Archaeological and Aboriginal Relics Preservation Act* 1972. There are substancial penalties under both Acts for the unauthorised disturbance of Aboriginal sites.

The Otway region has been divided into three Archaeological Sensitivity Zones based on Aboriginal site density and distribution (table 22, figure 24). The location of potential developments can be easily plotted on the Archaeological Sensitivity Zone map (figure 24) for a preliminary assessment of the likely impact of such projects to alert planners of the necessity of having archaeological impact assessments undertaken, and as a basis of predicting the costs of impact assessments and, if necessary, site mitigation (i.e. salvage excavation and/or surface collection). Sensitivity Zones 1 and 2 are of high archaeological sensitivity and any land-altering activities should be subject to impact assessment prior to commencement of ground disturbance. Land-altering activities are less likely to impact sites in Sensitivity Zone 3 than in the other two zones, however, there is still a considerable threat to sites from large-scale disturbances such as logging coupes or agricultural land clearance. Ridge tops in Sensitivity Zone 3 should be particularly avoided (except those logged within the past 40 years) as this is where the highest density of sites is present.

Land scheduled for logging, reforestation or conversion to tree plantations in Sensitivity Zones 1 and 2 should be subject to impact assessment well ahead of project commencement. In Sensitivity Zone 3, only ridge or hill tops and upper slopes should be subject to impact assessment. Tree plantations and coupes logged since the late 1960s have very low archaeological potential due to the severity of disturbance and no impact assessments are necessary for further developments, despite their location or Sensitivity Zone. Because of the high site-destruction level inherent in plantations, it is essential to evaluate thoroughly the archaeological values of proposed plantation areas. Since the archaeological record in such areas will be effectively destroyed, surveying and detailed impact assessments should be undertaken. Known sites and sensitive areas should be excluded from the plantation or mitigation involving excavation must take place.

Any ground to be modified for agricultural purposes or grazing should be subject to impact assessment well in advance of clearing unless it is located on the mid to lower slopes of landforms in Sensitivity Zone 3. Previously cleared grazing land to be used for potato growing should also be subject to impact assessment because of the site-destructive nature of potato harvesting (see chapter 2).

The construction or upgrading of tourist facilities in the study area, which mainly occur along the coast in Sensitivity Zone 1, should be strictly monitored as this area contains dense and diverse archaeological sites. Especially destructive are road and track construction and any clearing and levelling activities associated with construction of buildings. Hiking or riding trails are relatively narrow, but their construction or upgrading can still disturb sites.

Increased tourism is likely to result in an increase in disturbance to archaeological sites through visitors picking up artefacts from sites. On a general level there is little to be done besides attempting to educate the public, but such activities can be explicitly discouraged within parks either with pamphlets or signs at easily accessible sites.

Development and expansion of the towns and villages in the Otway Study Area is likely to have an impact on archaeological sites through the construction of roads, sewerage systems, housing developments and foreshore construction projects. The consideration of archaeological sites should be an integral part of the planning, especially for those centres along the coast where any sizeable development is likely to have an impact on archaeological sites.

It appears that water demand outside the study area will increase, requiring further exploitation of the Otway catchments:

> Strategies to meet the increasing water demand in the region are presently being examined. It will involve more intensive development of existing surface water and groundwater source areas, and using previously untouched water resources. Possibilities include the construction of storage facilities on Roadknight Creek, Dewing Creek, or Callahan Creek (Barwon River tributaries), or diversions from the Gellibrand River (Brinkman and Farrell 1990:102).

These tributaries of the Barwon are largely located in Sensitivity Zone 2 and large-scale flooding would probably impact on numerous potentially significant sites. Portions of the Gellibrand River are present in all three zones, but any diversion of water outside the study area would probably pass through Sensitivity Zone 2 which is particularly archaeologically sensitive. A preliminary idea of the likely impact on archaeological sites can be obtained by consulting the archaeological sensitivity map (figure 24) whenever plans for these possible developments become available.

Any archaeological sites within a quarry pit will be destroyed, so it is strongly recommended that major expansion of existing quarries and proposals for new quarries within Sensitivity Zones 1 and 2 should be preceded by impact assessments. Unless on a very large scale, it is less likely that quarries will impact on sites within Sensitivity Zone 3.

The Wonga Training Area used by both the Army and Air Force for field training exercises is located at the north-western edge of the study area (Brinkman and Farrell 1990:120). Current uses of the 9500 ha area, about 60 per cent of which is in the study area (Sensitivity Zone 2), pose no immediate threat to archaeological sites. If roads or facilities are constructed, however, or tracked vehicles are employed in exercises, sites could be adversely affected. Any construction should be preceded by impact assessment.

Aboriginal Community Comments

A draft version of this report was submitted to representatives of the Wathaurong Aboriginal Co-operative and the Framlingham Aboriginal Trust for comment so that any concerns could be addressed before the contents were finalised. Representatives of both organisations were satisfied with the contents of the report and provided statements for inclusion.

Framlingham Aboriginal Trust representative Mr Lionel Harradine made the following statement:

> The Framlingham Aboriginal Trust is very pleased with the archaeological work that was done. The report is very comprehensive and if all archaeological studies were of this quality we would have an excellent library of information.

Mr Trevor Edwards (Chairman of the Board) and Mr Allan Browning (Cultural Officer) of the Wathaurong Aboriginal Co-operative provided this four point statement:

1. The Wathaurong Aboriginal Co-operative is the custodian of Aboriginal sites within the Community boundary.
2. All Aboriginal sites are of importance to the Wathaurong Community because they provide an important link to the past.
3. The Wathaurong Community regard the focus on 'artefacts' and 'sites' to be a European approach to Aboriginal heritage. To the Wathaurong, a locality or place has more importance than the artefacts on or in it, because of a spiritual connection with the land itself. The natural context of a place is an integral part of its heritage and this context can often extend beyond the boundaries of an archaeological site.
4. The Wathaurong want to emphasise the necessity of archaeologists using subsurface testing methods when surveying areas with poor surface visibility or in any cultural heritage management situation where it is suspected that buried occupation deposits are present.

References

Ambler, R. J. 1984

The Use and Abuse of Predictive Modelling in Cultural Resource Management. *American Archaeology* 4(2):140–146.

Binford, Lewis R. 1980

Willow Smoke and Dogs' Tails: Hunter-Gatherer Systems and Archaeological Site Formation. *American Antiquity* 45:4–20.

Bowdler, Sandra 1981

Unconsidered Trifles? Cultural Resource Management, Environmental Impact Statements and Archaeological Research in New South Wales. *Australian Archaeology* 12: 123–133.

Bowdler, Sandra 1984

Archaeological Significance as a Mutable Quality. In *Site Surveys and Significance Assessment*, Edited by S. Sullivan and S. Bowdler, pp. 1–9. Department of Prehistory, Research School of Pacific Studies, Australian National University, Canberra.

Bride, T. F. (Ed.) 1898

Letters from Victorian Pioneers. Heinemann, Melbourne.

Brinkman, R. and S. Farrell 1990

Statement of Resources, Uses and Values for the Otway Forest Management Area. Department of Conservation and Environment, Victoria.

Brose, D. S. 1984

Response to King and Plog. *American Archaeology* 4(2):96–97.

Chadzynski, Andre W. 1981

Aboriginal Tribal Territory, Boundaries, and the Physical Environment in Western Victoria. B.A. Honours Thesis, Department of Geography, University of Melbourne, Melbourne.

Clark, David J. 1983

Report on Human Skeletal Material Recovered by Iain-Malcolm Stuart at the Hordern Road Site-75202/018. File note, Aboriginal Affairs Victoria, Melbourne.

Clark, Ian D. 1990

Aboriginal Languages and Clans: An Historical Atlas of Western and Central Victoria, 1800–1900. Monash Publications in Geography No. 37. Department of Geography and Environmental Science, Monash University, Melbourne.

Clark, R. H. and A. J. Schofield 1991

By Experiment and Calibration: An Integrated Approach to Archaeology of the Ploughsoil. In *Interpreting Artefact Scatters: Contributions to Ploughzone Archaeology*, edited by A. J. Schofield, pp. 93–105. Oxbow Monograph 4. Oxbow Books, Oxford.

Condie, C. J. 1984

Response to King and Plog. *American Archaeology* 4(2):98.

Custer, J. F., T. Eveleigh, V. Klemas and I. Wells 1986

Application of Landsat Data Synoptic Remote Sensing to Predictive Models for Prehistoric Archaeological Sites: An Example from the Delaware Coastal Plain. *American Antiquity* 51(3):572–588.

Dawson, J. 1881

The Australian Aborigines: The Languages and Customs of Several Tribes of Aborigines in the Western District of Victoria, Australia. George Robertson, Melbourne.

du Cros, Hilary 1990

The Otways Region Archaeological Study Stage 1. Victoria Archaeological Survey Occasional Report No. 28. Department of Conservation and Environment, Melbourne.

Elliot, A. C. 1994

Kwikstat Statistical Data Analysis Program. Version 4 Users Manual. Texasoft Products, Cedar Hill.

Fletcher, M. and G. R. Lock 1994

Digging Numbers: Elementary Statistics for Archaeologists. Oxford University Committee for Archaeology, Oxford.

Fullagar, Richard L. K. 1982

What's the Use?: An Analysis of Aire Shelter II, Glenaire, Victoria. M.A. (Prelim.) Thesis, Division of Prehistory, La Trobe University, Melbourne.

Gould, R. A. 1969

Puntutjarpa Rockshelter: A Reply to Messrs. Glover and Lampert. *Archaeology and Physical Anthropology in Oceania* 4 (3): 229-237.

Hall, Roger n.d.

Far East Gippsland Survey. Ms, Aboriginal Affairs Victoria, Melbourne.

Head, Lesley and Iain M. F. Stuart 1980

Change in the Aire: Palaeoecology and Prehistory in the Aire Basin, Southwestern Victoria. Monash Publications in Geography No. 24, Department of Geography, Monash University, Melbourne.

Jarman, M. R. 1972

A Territorial Model for Archaeology: A Behavioural and Geographical Approach. In *Models in Archaeology*, Edited by D.L Clark, pp. 705–734. Methuen, London.

King, T. F. 1984

The OSMPMOA is Coming! *American Archaeology* 4(2):83–88.

Kvamme, K. L. 1985

Determining Empirical Relationships Between the Natural Environment and Prehistoric Site Locations: A Hunter-Gatherer Example. In *For Concordance in Archaeological Analysis*, edited by C. Carr, pp. 208–238. Westport Publishers, Inc., Kansas City.

Larralde, Signa L., and Susan M. Chandler 1981

Archaeological Inventory in the Seep Ridge Cultural Study Tract, Uintah County, Utah, With a Regional Predictive Model for Site Location. Utah Cultural Resource Series II. Bureau of Land Management, Utah.

LTU n.d.

La Trobe University, School of Archaeology site record cards, student essays and Dr. N. Stern, personal communication, June 1991, pertaining to the Apollo Bay to Lorne survey.

Lewarch, Dennis E. and Michael J. O'Brien 1981

Effect of Short Term Tillage on Aggregate Provenience Surface Pattern. In *Plowzone Archaeology: Contributions to Theory and Technique*, edited by M.J. O'Brien and D.E. Lewarch, pp. 7–50. Vanderbilt University Publications in Anthropology No. 27, Nashville.

Lourandos, H. 1980

Forces of Change: Aboriginal Technology and Population in South-Western Victoria. Ph.D. Thesis, University of Sydney, Sydney.

Lourandos, H. 1983

Intensification: a Late Pleistocene-Holocene Archaeological Sequence from Southwestern Victoria. *Archaeology in Oceania* 18(2):81–94.

Lunt, I. D. 1989

Floristic Descriptions of the Vegetation of the Otway Area. MS, Flora and Fauna Survey Group, Department of Conservation and Environment, Victoria.

Lynch, B. M. 1980

Site Artifact Density and the Effectiveness of Shovel Probes. *Current Anthropology* 21(4) 1980:516–517.

Massola, A. 1962

The Grinding Rocks at Gellibrand. *Victorian Naturalist* 79:66–69.

Mendenhall, W., J. Reinmuth and R. Beaver 1989

Statistics for Management and Economics, Sixth Edition. PWS-Kent Publishing Company, Boston.

McManamon, Francis P. 1984

Discovering Sites Unseen. In *Advances in Archaeological Method and Theory Volume 7*, edited by M.B. Schiffer, pp. 223–292. Academic Press, New York.

Millar, James F. V. 1984
Qu'Appelle Basin Heritage Resources Sensitivity Mapping Project. Report to Heritage Resources Branch, Saskatchewan Culture and Recreation. Resource Centre Library, Saskatchewan Parks, Recreation and Culture, Regina.

Mitchell, Scott 1988
Chronological Change in Intensity of Site Use at Seal Point: A Technological Analysis. B.A. Honours Thesis, Department of Anthropology and Sociology, University of Queensland, Brisbane.

Mulvaney, D. J. 1962
Archaeological Excavations on the Aire River, Otway Peninsula, Victoria. *Proceedings of the Royal Society of Victoria* 75:1–15.

Nance, Jack D. and Bruce F. Ball 1986
No Surprises? The Reliability and Validity of Test Pit Sampling. *American Antiquity* 51(3):457–483.

Parker, Sandra L. 1985
Predictive Modelling of Site Settlement Systems Using Multivariate Logistics. In *For Concordance in Archaeological Analysis*, edited by C. Carr, pp. 173–207. Westport Publishers, St. Louis, Missouri.

Pitt, A. J. 1981
A Study of Land in the Catchments of the Otway Range and Adjacent Plains. Soil Conservation Authority Technical Report Series No. TC-19, Soil Conservation Authority, Victoria.

Plog, Fred 1984
The McKinley Mine and the Predictive Model, Limited Survey Approach: The Archaeology of Red Herrings. *American Archaeology* 4(2):89–95.

Presland, Gary 1982
An Archaeological Survey of the Otway Forest Region. Victoria Archaeological Survey Occasional Report Series No. 8, Melbourne.

Richards, Thomas 1984
A Model of the Mid-Nineteenth Century Settlement/Subsistence System of the Plains Cree and Assiniboine in Southern Saskatchewan and its Application to the Qu'Appelle Valley. Report prepared for the Qu'Appelle Basin Heritage Resource Sensitivity Mapping Project. Resource Centre Library, Saskatchewan Parks, Recreation and Culture, Regina.

Richards, Thomas, Carlos Germann, John Storer, Kit Kroszer, Phillippa Sutherland Richards and Jeff Minto 1989
South Saskatchewan River Basin Study Heritage Resources. Saskatchewan Water Corporation and Environment Canada, Moose Jaw.

Rogge, A. E. and T. R. Lincoln 1987
Predicting the Distribution of Archaeological Sites: A Case Study from the Central Arizona Project. *American Archaeology* 6(2):140–150.

Scarlett, N. H. 1977
The Aborigines of the Otway Region. *Proceedings of the Royal Society of Victoria* 89 (1): 1–6.

Scott-Virtue, E. L. 1982
Flint: The Foundation For a Hypothesis. B.A. Honours Thesis, Prehistory Division, La Trobe University, Melbourne.

Smyth, R. B. 1878
The Aborigines of Victoria. Victorian Government Printer, Melbourne.

Speight, J.G. 1984 Landform.
An Australian Soil and Land Survey Field Handbook, edited by R.C. McDonald, R.F. Isbell, J.G. Speight, J. Walker and M.S. Hopkins, pp. 8–43. Inkata Press, Melbourne.

Stone, Glenn Davis 1981
On Artifact Density and Shovel Probes. *Current Anthropology* 22(2):182–183.

Stuart, Iain M. F. 1979
A Site Survey and Settlement Pattern Study of the Glen Aire Valley, Otway Ranges, Victoria. B.A. Honours Thesis, Division of Prehistory, La Trobe University, Melbourne.

Stuart, Iain M.F. 1981
Ethnohistory in the Otway Ranges. *The Artefact* 6 (1–2):79–88.

Thomas, David H. 1972
A Computer Simulation Model of Great Basin Shoshonean Subsistence and Settlement Patterns. In *Models in Archaeology*, edited by David L. Clarke, pp. 671–704. Methuen, London.

White, J. P. and J. F. O'Connell. 1982
A Prehistory of Australia, New Guinea and Sahul. Academic Press, Sydney.

Witter, Dan C. n.d.
An Archaeological Survey of Apollo Bay and the Otways. Ms, Aboriginal Affairs Victoria, Melbourne.

Zallar, S. A., K. Siow and P. J. F. Coutts 1979
Stabilisation of Coastal Archaeological Sites in Victoria: A Pilot Study. Soil Conservation Authority and Victoria Archaeological Survey, Ministry for Conservation, Melbourne.

Zobel, D. E. 1982
Moonlight Head Midden. B.A. Honours Thesis, Prehistory Division, La Trobe University, Melbourne.

Zobel, D. E., R. L. Vanderwal and D. Frankel 1984
The Moonlight Head Rockshelter. *Proceedings of the Royal Society of Victoria* 96:1–24.

Appendix. Otway Study Area Site Gazetteer

Site Reg.	SZ	Site Type	Site Area	Cond.	Chip Arts	FT	AS-TT	GR	HR	Cond. Rate	Size Rate	Art Rate	Div. Rate	Rare Rate	Rate Score	Signif.
7520/003	1	RS	25	Fair	+	+	–	–	–	0	1	3	2	9	9+	High
7520/005	1	SM	0	Fair	0	–	–	–	–	2	2	3	3	0	10	High
7520/006	1	SM	0	Poor	0	–	–	–	–	1	2	3	3	0	9	High
7520/007	1	SM	0	Poor	0	–	–	–	–	1	2	2	2	0	7	Mod.
7520/008	1	RS	0	Good	0	–	–	–	–	3	1	1	3	9	12	High
7520/009	2	AS	0		0	–	–	–	–	0	1	1	1	0	3+	Low
7520/010	1	SM	0	Fair	0	–	–	–	–	2	3	3	2	0	10	High
7520/011	1	SM	0	Fair	0	–	–	–	–	2	3	3	2	0	10	High
7520/012	1	AS	–	Dest.	–	–	–	–	–	–	–	–	–	–	–	–
7520/013	1	AS	150	Poor	0	–	–	–	–	1	2	2	1	0	6+	Mod.
7520/014	1	AS	0	Poor	0	–	–	–	–	1	1	2	1	0	5+	Mod.
7520/015	1	AS	0	Poor	0	–	–	–	–	1	1	2	1	0	5+	Mod.
7520/016	1	SM	625	Poor	0	–	–	–	–	1	2	2	3	0	8+	Mod.
7520/017	1	SM	512	Poor	0	–	–	–	–	1	2	1	3	0	7+	Mod.
7520/018	1	HB,SM	4800		+	+	–	+	+	1	3	2	3	9	10+	High
7520/023	3	CO	–	–	–	–	–	–	–	–	–	–	–	–	–	–
7520/024	1	SM	25	Poor	3	+	–	–	–	1	1	2	3	0	7	Mod.
7520/025	1	SM	25	Poor	2	+	–	–	–	1	1	2	2	0	6	Mod.
7520/026	1	SM	23000	Poor	3	+	–	–	–	1	3	2	2	0	8	Mod.
7520/027	1	SM	50	Poor	2	+	–	–	–	1	1	2	2	0	6	Mod.
7520/028	3	IF			1	–	–	–	–	1	1	2	1	0	5+	Mod.
7520/029	1	RS,SM		Good	0	–	–	–	–	3	3	3	3	9	12	High
7520/030	1	SM	128	Poor	0	–	–	–	–	1	2	2	3	0	8+	Mod.
7520/031	1	SM	1250	Poor	0	–	–	–	–	1	3	2	3	0	9+	High
7520/032	1	SM	0	Fair	0	–	–	–	–	2	1	3	3	0	9+	High
7520/033	1	SM	200	Fair	4	+	–	–	–	2	2	2	2	0	8	Mod.
7520/034	1	SM	225	Fair	5	+	+	+	–	2	2	2	3	0	9	High
7520/035	1	SM	25	Fair	1	–	–	–	–	2	1	1	2	0	6	Mod.
7520/036	1	NS	–	–	–	–	–	–	–	–	–	–	–	–	–	–
7520/037	1	SM	250	Fair	3	+	–	–	+	2	2	2	3	0	9	High
7520/038	1	SM	25	Fair	3	+	–	–	+	2	1	2	3	0	8	Mod.
7520/039	1	SM	480	Poor	3	+	–	–	–	1	2	2	2	0	7	Mod.
7520/040	1	SM	1000	Poor	4	+	–	+	–	1	3	2	3	0	9	High
7520/041	1	AS	25	Good	2	+	–	–	–	3	1	3	1	0	8	Mod.
7520/042	1	AS	240	Poor	3	+	+	–	–	1	2	3	2	0	8	Mod.
7520/043	1	SM	100	Good	2	–	–	–	–	3	2	2	2	0	9	High
7520/044	1	SM	25	Poor	3	+	–	–	–	1	1	2	2	0	6	Mod.
7520/045	1	SM	25	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7520/046	1	SM	25	Poor	1	–	–	–	–	1	1	1	2	0	5	Mod.
7520/047	1	SM	100	Fair	2	+	–	–	–	2	2	2	2	0	8	Mod.
7520/048	1	SM	400	Fair	2	+	–	–	–	2	2	2	2	0	8	Mod.
7520/049	1	IF	1	Fair	1	+	–	–	–	2	1	1	1	0	5	Mod.
7520/050	1	SM	25	Fair	1	+	–	–	–	2	1	1	2	0	6	Mod.
7520/051	1	SM	25	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/052	1	SM	400	Good	1	–	–	–	–	3	2	1	2	0	8	Mod.
7520/053	1	SM	100	Fair	1	–	–	–	–	2	2	1	2	0	7	Mod.
7520/054	1	SM	20000	Fair	1	+	–	–	–	2	3	1	2	0	8	Mod.
7520/055	1	SM	25	Fair	2	+	–	–	–	2	1	2	2	0	7	Mod.
7520/056	1	SM	113	Poor	0	–	–	–	–	1	2	1	1	0	5	Mod.
7520/059	1	SM	50000	Good	2	+	–	–	–	3	3	2	2	0	10	High
7520/060	1	SM	1250	Good	1	–	–	–	–	3	3	1	2	0	9	High
7520/061	1	SM	450	Poor	0	–	–	–	–	1	2	1	1	0	5	Mod.

Site Reg.	SZ	Site Type	Site Area	Cond.	Chip Arts	FT	AS-TT	GR	HR	Cond. Rate	Size Rate	Art Rate	Div. Rate	Rare Rate	Rate Score	Signif.
7520/062	1	SM	1	Poor	0	–	–	–	–	1	1	1	1	0	4	Low
7520/063	1	SM	200	Poor	2	+	–	–	–	1	2	2	2	0	7	Mod.
7520/064	1	SM	1	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/065	1	SM	2	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7520/066	1	SM	25	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7520/067	1	SM	25	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/068	1	NS	–	–	–	–	–	–	–	–	–	–	–	–	–	–
7520/069	1	AS	25	Fair	3	+	–	–	–	2	1	3	1	0	7	Mod.
7520/070	1	AS	25	Fair	3	+	–	–	–	2	1	3	1	0	7	Mod.
7520/071	3	AS	25	Fair	3	+	–	–	–	2	2	3	2	0	9	High
7520/072	1	SM	25	Fair	1	–	–	–	–	2	1	1	2	0	6	Mod.
7520/073	1	SM	450	Good	1	–	–	–	–	3	2	1	2	0	7	Mod.
7520/074	1	SM	100	Good	4	+	–	–	–	3	2	2	2	0	9	High
7520/075	1	SM	8	Good	1	–	–	–	–	3	1	1	2	0	7	Mod.
7520/076	1	SM	50	Good	1	+	–	–	–	3	1	1	2	0	7	Mod.
7520/077	1	SM	50	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/078	1	SM	50	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/079	1	SM	1	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7520/080	1	SM	1	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/081	1	SM	1	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/082	1	SM	1	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/083	1	SM	200	Fair	0	–	–	–	–	2	2	1	1	0	6	Mod.
7520/084	1	SM	1	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/085	1	SM	1	Fair	2	+	–	–	–	2	1	2	2	0	7	Mod.
7520/086	1	SM	1	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/087	1	SM	1	Good	1	+	–	–	–	3	1	1	2	0	7	Mod.
7520/088	1	SM	450	Good	1	–	–	–	–	3	2	1	2	0	8	Mod.
7520/089	1	SM	5	Good	2	+	–	–	+	3	1	2	3	0	9	High
7520/090	1	SM	2100	Good	2	+	–	–	–	3	3	2	2	0	10	High
7520/091	1	SM	25	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7520/092	1	SM	25	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7520/093	1	SM	450	Good	0	–	–	–	–	3	2	1	1	0	7	Mod.
7520/094	1	SM	25	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/095	1	SM	25	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/096	1	SM	25	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/097	1	SM	5	Good	1	+	–	–	–	3	1	1	2	0	7	Mod.
7520/098	1	SM	1000	Good	0	–	–	–	–	3	3	1	1	0	8	Mod.
7520/099	1	SM	50	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7520/100	1	SM	450	Good	1	+	–	–	–	3	2	1	2	0	8	Mod.
7520/101	1	RS	30	Good	1	–	–	–	–	3	1	1	1	9	12	High
7520/102	1	SM	25	Good	1	–	–	–	–	3	1	1	2	0	7	Mod.
7520/103	1	SM	400	Fair	0	–	–	–	–	2	2	2	2	0	8	Mod.
7520/104	1	SM	2500	Fair	0	–	–	–	–	2	3	2	3	0	10	High
7520/105	3	AS	100	Fair	0	–	–	–	–	2	3	2	1	0	8	Mod.
7520/106	1	CO	–	–	–	–	–	–	–	–	–	–	–	–	–	–
7520/107	1	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7520/108	1	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7520/109	1	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7520/110	1	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7520/111	3	IF	1	Poor	1	–	–	–	–	1	1	1	1	0	4	Low
7520/112	3	IF	1	Poor	1	–	–	–	–	1	1	1	1	0	4	Low
7520/113	3	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.

Site Reg.	SZ	Site Type	Site Area	Cond.	Chip Arts	FT	AS-TT	GR	HR	Cond. Rate	Size Rate	Art Rate	Div. Rate	Rare Rate	Rate Score	Signif.
7520/114	3	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7520/115	3	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7520/116	2	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7520/117	2	CO	–	–	–	–	–	–	–	–	–	–	–	–	–	–
7520/118	2	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7520/119	2	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/001	3	GG	0	Good	0	–	–	–	–	3	1	0	1	9	12	High
7620/002	3	NS	–	–	–	–	–	–	–	–	–	–	–	–	–	–
7620/003	3	HB	0		0	–	–	–	–	0	1	0	0	9	9+	High
7620/004	1	SM	0		0	–	–	–	–	0	1	1	1	0	3+	Low
7620/005	1	SM	99900	Good	0	–	–	–	–	3	3	1	1	0	8	Mod.
7620/006	3	MD	0		0	–	–	–	–	0	1	0	1	9	9+	High
7620/007	1	SM	240	Poor	0	–	–	–	+	1	2	1	2	0	6	Mod.
7620/008	1	SM	0		0	–	–	–	–	0	1	1	1	0	3+	Low
7620/009		AS	0		0	–	–	–	–	0	1	1	0	0		
7620/010	1	SM	113	Fair	2	+	–	–	–	2	2	2	2	0	8	Mod.
7620/011	1	SM	313	Fair	0	–	–	–	–	2	2	1	1	0	6	Mod.
7620/012	1	SM	21	Fair	0	–	–	–	–	2	1	1	1	0	5+	Mod.
7620/013	1	SM	210	Fair	0	–	–	–	–	2	1	1	1	0	5+	Mod.
7620/014	3	IF	0	Fair	1	–	–	–	–	2	1	1	1	0	5+	Mod.
7620/015	1	SM	72	Fair	1	–	–	–	+	2	1	1	3	0	7	Mod.
7620/016	1	SM	10	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/017	1	SM	800	Good	5	+	–	–	+	3	2	2	3	0	10	High
7620/018	1	SM	176	Fair	1	–	–	–	+	2	2	1	3	0	8	Mod.
7620/019	1	SM	2000	Fair	3	+	–	–	+	2	3	2	3	0	10	High
7620/020	1	SM	22000	Fair	3	+	–	–	+	2	3	2	3	0	10	High
7620/021	3	AS	7650	Fair	0	–	–	–	–	2	3	3	1	0	9	High
7620/022	1	AS	3000	Poor	12	+	–	–	–	1	3	3	1	0	8	Mod.
7620/023	1	AS	90	Poor	11	–	–	–	–	1	1	3	1	0	6	Mod.
7620/024	1	AS	3125	Fair	175	+	+	–	–	2	3	3	2	0	10	High
7620/025	1	AS	6900	Fair	0	–	–	–	–	2	3	2	2	0	9+	High
7620/026	1	AS	500	Fair	0	–	–	–	–	2	2	2	3	0	9+	High
7620/027	1	AS	1200	Good	0	–	–	–	–	3	3	2	3	0	11	High
7620/028	1	AS	13500	Poor	41	–	–	–	–	1	3	3	2	0	9	High
7620/029	1	AS	10800	Fair	59	+	–	–	–	2	3	3	2	0	10	High
7620/030	1	SM	2	Fair	1	+	–	–	–	2	1	1	2	0	6	Mod.
7620/031	1	AS	360	Fair	28	+	–	–	–	2	2	3	1	0	8	Mod.
7620/032	1	LQ	4000	Fair	109	–	+	–	–	2	3	3	2	9	11	High
7620/033	1	AS	6	Fair	22	–	–	–	–	2	1	3	2	0	8	Mod.
7620/034	2	AS	1400	Fair	84	–	–	–	–	2	3	3	1	0	10	High
7620/035	1	AS	72	Fair	52	–	–	–	–	2	1	3	2	0	8	Mod.
7620/036	1	SM	3000	Fair	0	–	–	–	–	2	3	1	1	0	7	Mod.
7620/037	1	SM	2600	Poor	0	–	–	–	–	1	3	1	1	0	6	Mod.
7620/038	1	SM	3000	Fair	0	–	–	–	–	2	3	1	1	0	7	Mod.
7620/039	1	SM	1400	Fair	0	–	–	–	–	2	3	1	1	0	7	Mod.
7620/040	1	AS	125	Poor	23	+	+	–	–	1	2	3	2	0	8	Mod.
7620/041	1	SM	5000	Good	1	+	–	–	–	3	3	1	2	0	9	High
7620/042	1	SM	2500	Good	0	–	–	–	+	3	3	1	2	0	9	High
7620/043	1	SM	5000	Poor	0	–	–	–	+	1	3	1	2	0	7	Mod.
7620/044	1	SM	13	Fair	4	+	–	–	–	2	1	2	3	0	8	Mod.
7620/045	1	SM	0	Poor	0	–	–	–	–	1	1	1	1	0	4+	Low
7620/046	1	SM	100	Fair	0	–	–	–	–	2	2	1	1	0	6	Mod.

Site Reg.	SZ	Site Type	Site Area	Cond.	Chip Arts	FT	AS-TT	GR	HR	Cond. Rate	Size Rate	Art Rate	Div. Rate	Rare Rate	Rate Score	Signif.
7620/047	1	SM	30	Poor	0	–	–	–	–	1	1	1	3	0	6+	Mod.
7620/048	1	SM	1250	Poor	0	–	–	–	–	1	3	2	2	0	8+	Mod.
7620/049	1	SM	20	Poor	0	–	–	–	–	1	1	2	3	0	7+	Mod.
7620/050	1	SM	30	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/051	1	RS,SM	0	Poor	0	–	–	–	–	1	1	1	2	9	10	High
7620/052	1	SM	0	Fair	0	–	–	–	–	2	1	1	1	0	5+	Mod.
7620/053	1	SM	100	Poor	0	–	–	–	–	1	2	2	3	0	8+	Mod.
7620/054	1	SM	125	Poor	0	–	–	–	–	1	2	1	1	0	5	Mod.
7620/055	1	SM	250	Poor	0	–	–	–	–	1	2	1	1	0	5	Mod.
7620/056	1	SM	100	Poor	0	–	–	–	–	1	2	1	1	0	5	Mod.
7620/057	1	SM	40	Poor	0	–	–	–	–	1	1	1	1	0	4	Low
7620/058	1	SM	20	Poor	0	–	–	–	–	1	1	1	1	0	4	Low
7620/059	1	SM	1200	Poor	0	–	–	–	–	1	3	1	1	0	6	Mod.
7620/060	1	SM	400	Poor	0	–	–	–	–	1	2	1	1	0	5	Mod.
7620/061	1	SM	20	Poor	0	–	–	–	–	1	1	1	1	0	4	Low
7620/062	1	SM	5000	Poor	0	–	–	–	–	1	3	1	1	0	6	Mod.
7620/063	1	RS,SM	15	Fair	0	–	–	–	–	2	1	1	1	9	11	High
7620/064	1	RS,SM	0	Poor	0	–	–	–	–	1	1	1	1	9	10	High
7620/065	1	RS,SM	0	Fair	0	–	–	–	–	2	1	1	1	9	11	High
7620/066	1	AS	2300	Fair	0	–	–	–	–	2	3	3	3	0	11	High
7620/067	1	SM	12300	Good	0	–	–	–	–	3	3	1	1	0	8	Mod.
7620/068	1	SM	0	Poor	0	–	–	–	–	1	1	1	1	0	4+	Low
7620/069	1	SM	800	Fair	2	–	–	–	–	2	2	2	2	0	8	Mod.
7620/070	1	SM	5	Fair	3	–	+	–	+	1	2	3	2	0	8	Mod.
7620/071	1	SM	162	Fair	0	–	–	–	–	2	2	1	1	0	6	Mod.
7620/072	1	SM	313	Poor	0	–	–	–	–	1	2	1	1	0	5	Mod.
7620/073	1	SM	1250	Fair	0	–	–	–	–	2	3	1	1	0	7	Mod.
7620/074	1	SM	450	Fair	0	–	–	–	+	2	2	1	2	0	7	Mod.
7620/075	1	SM	162	Good	0	–	–	–	–	3	2	1	1	0	7	Mod.
7620/076	1	SM	1	Good	0	–	–	–	+	3	1	1	2	0	7	Mod.
7620/077	1	SM	2	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7620/078	1	SM	8	Poor	2	+	–	–	+	1	1	2	3	0	7	Mod.
7620/079	1	SM	5	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7620/080	1	SM	113	Fair	0	–	–	–	–	2	2	1	1	0	6	Mod.
7620/081	1	SM	1	Fair	1	–	–	–	–	2	1	1	2	0	6	Mod.
7620/082	1	SM	25	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/083	1	SM	190	Fair	2	+	–	–	–	2	2	2	2	0	8	Mod.
7620/084	1	SM	6	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/085	1	SM	5	Poor	0	–	–	–	–	1	1	1	1	0	4	Low
7620/086	1	SM	1250	Fair	0	–	–	–	–	2	3	1	1	0	7	Mod.
7620/087	1	SM	1800	Fair	0	–	–	–	–	2	3	1	1	0	7	Mod.
7620/088	1	SM	30	Fair	1	–	–	–	–	2	1	1	2	0	6	Mod.
7620/089	1	SM	13	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/090	1	SM	2	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/091	1	SM	5	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/092	1	SM	2	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/093	1	SM	13	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/094	1	SM	13	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/095	1	SM	2400	Poor	2	+	+	–	–	1	3	2	2	0	8	Mod.
7620/096	1	SM	1	Poor	0	–	–	–	–	1	1	1	1	0	4	Low
7620/097	1	SM	5	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/098	1	SM	18	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.

Site Reg.	SZ	Site Type	Site Area	Cond.	Chip Arts	FT	AS-TT	GR	HR	Cond. Rate	Size Rate	Art Rate	Div. Rate	Rare Rate	Rate Score	Signif.
7620/099	1	SM	72	Good	1	+	+	–	–	3	1	1	2	0	7	Mod.
7620/100	1	SM	6	Poor	0	–	–	–	–	1	1	1	1	0	4	Low
7620/101	1	SM	25	Good	0	–	–	–	+	3	1	1	2	0	7	Mod.
7620/102	1	SM	10	Good	0	–	–	–	–	3	1	1	1	0	6	Mod.
7620/103	1	SM	1	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/104	1	SM	5	Fair	1	–	+	–	–	2	1	1	2	0	6	Mod.
7620/105	1	SM	3	Fair	0	–	–	–	–	2	1	1	1	0	5	Mod.
7620/106	1	SM	113	Fair	0	–	–	–	+	2	2	1	2	0	7	Mod.
7620/107	1	SM	2	Poor	0	–	–	–	–	1	1	1	1	0	4	Low
7620/108	1	SM	450	Fair	2	+	+	–	–	2	2	2	2	0	8	Mod.
7620/109	3	AS	100	Poor	8	–	–	–	–	1	3	3	2	0	9	High
7620/110	3	AS	9	Poor	2	–	–	–	–	1	1	3	1	0	6	Mod.
7620/111	3	AS	192	Poor	8	–	–	–	–	1	3	3	2	0	9	High
7620/112	3	IF	1	Poor	1	–	–	–	–	1	1	1	1	0	4	Low
7620/113	3	IF	1	Poor	1	–	–	–	–	1	1	1	1	0	4	Low
7620/114	1	AS	4000	Fair	21	+	–	+	–	2	3	3	2	0	10	High
7620/115	1	IF	1	Fair	1	–	–	–	+	2	1	1	2	0	6	Mod.
7620/116	1	AS	20	Fair	3	+	–	–	–	2	1	3	1	0	7	Mod.
7620/117	1	AS	1000	Fair	17	+	–	–	+	2	3	3	3	0	11	High
7620/118	1	AS	5	Fair	2	+	–	–	–	2	1	3	1	0	7	Mod.
7620/119	1	AS	50	Fair	3	+	–	+	–	2	1	3	2	0	8	Mod.
7620/120	1	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/121	1	AS	7200	Fair	100	+	–	+	–	2	3	3	3	0	11	High
7620/122	3	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/123	3	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/124	3	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/125	2	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/126	2	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/127	2	AS	3744	Fair	75	+	+	–	–	2	3	3	3	0	11	High
7620/128	2	AS	63	Fair	6	–	–	–	–	2	2	3	2	0	9	High
7620/129	2	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/130	2	AS	5	Fair	2	–	–	–	–	2	1	3	1	0	7	Mod.
7620/131	2	AS	1176	Fair	19	+	–	–	–	2	3	3	3	0	11	High
7620/132	2	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/133	2	AS	40	Fair	2	–	–	–	–	2	2	3	1	0	8	Mod.
7620/134	2	AS	1	Good	2	–	–	–	–	3	1	3	1	0	8	Mod.
7620/135	2	AS	50	Good	4	–	–	–	–	3	2	3	1	0	9	High
7620/136	1	AS	1320	Fair	7	+	–	–	–	2	3	3	2	0	10	High
7620/137	1	IF	1	Fair	1	+	–	–	–	2	1	1	1	0	5	Mod.
7620/138	1	AS	480	Fair	11	–	+	–	–	2	2	3	2	0	9	High
7620/139	1	AS	90	Fair	5	+	–	–	–	2	1	3	1	0	7	Mod.
7620/140	1	AS	48	Fair	5	–	+	–	–	2	1	3	1	0	7	Mod.
7620/141	1	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/142	1	AS	232	Fair	8	+	–	–	–	2	2	3	1	0	8	Mod.
7620/143	1	IF	1	Fair	1	+	–	–	–	2	1	1	1	0	5	Mod.
7620/144	1	IF	1	Fair	1	+	–	–	–	2	1	1	1	0	5	Mod.
7620/145	1	IF	1	Fair	1	+	–	–	–	2	1	1	1	0	5	Mod.
7620/146	1	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/147	1	IF	1	Fair	1	–	–	–	–	2	1	1	1	0	5	Mod.
7620/148	1	AS	700	Fair	17	–	+	–	–	2	2	3	2	0	9	High
7620/149	1	AS	155	Fair	5	+	–	–	–	2	2	3	1	0	8	Mod.
7620/150	1	AS	460	Fair	10	+	–	–	–	2	2	3	1	0	8	Mod.

Site Reg.	SZ	Site Type	Site Area	Cond.	Chip Arts	FT	AS-TT	GR	HR	Cond. Rate	Size Rate	Art Rate	Div. Rate	Rare Rate	Rate Score	Signif.
7620/151	1	AS	125	Fair	4	–	–	–	–	2	2	3	2	0	9	High
7620/152	1	AS	75	Fair	5	–	–	–	–	2	1	3	2	0	8	Mod.
7620/153	1	AS	100	Fair	6	–	–	–	–	2	2	3	1	0	8	Mod.
7620/154	1	AS	150	Fair	5	–	–	–	–	2	2	3	1	0	8	Mod.
7620/155	1	AS	200	Fair	6	–	–	–	–	2	2	3	2	0	9	High
7621/006	2	IF	0	Fair	1	–	–	–	–	2	1	1	1	0	5+	Low
7721/008	1	FT	–	Dest.	–	–	–	–	–	–	–	–	–	–	–	–
7721/040	1	SM	0	Poor	0	–	–	–	–	1	1	3	3	0	8+	Mod.
7721/041	1	SM	0	Fair	0	–	–	–	–	2	1	1	2	0	6+	Mod.
7721/042	1	SM	0	Fair	0	–	–	–	–	2	1	1	2	0	6+	Mod.
7721/043	1	SM	0	Fair	0	–	–	–	–	2	1	1	1	0	5+	Mod.
7721/044	1	SM	0	Fair	0	–	–	–	–	2	1	1	1	0	5+	Mod.
7721/045	1	SM	0	Fair	0	–	–	–	–	2	1	1	2	0	6+	Mod.
7721/046	1	SM	0	Poor	0	–	–	–	–	1	1	1	1	0	4+	Low
7721/047	1	SM	0	Fair	0	–	–	–	–	2	1	1	2	0	6+	Mod.
7721/048	1	SM	0	Poor	0	–	–	–	–	1	1	2	3	0	7+	Mod.
7721/049	1	HB	0		0	–	–	–	–	0	0	3	1	9	9+	High

Key

Site Reg—Aboriginal Affairs Victoria Site Registation Number: the four digits to the left of the slash refer to a 1:100,000 map sheet and the number to the right is the site identification number

SZ—Archaeological Sensitivity Zone (chapter 4; figure 25):

Zone 1, Southern Periphery of the Otway Range

Zone 2, Northern Periphery of the Otway Range

Zone 3, Interior of the Otway Range

Site Type—

IF	Isolated Find
AS	Artefact Scatter
SM	Shell Midden
RS	Rock Shelter
HB	Human Burial
LQ	Lithic Quarry
GG	Grinding Grooves
MD	Mound
FT	Fish Trap
CO	Private Artefact Collection
NS	Non-Site

Site Area—Total Area of Site in Square Metres

Cond.—Condition of Site:

Good, slight disturbance only
Fair, moderately disturbed
Poor, severely disturbed
Dest., destroyed

Chip Arts—Number of Chipped Stone Artefacts on Surface: a '+' indicates chipped stone is present, but a count is not available

FT—Chipped Flint Artefacts on Surface: + present, – absent

ASTT—Australian Small Tool Tradition Artefacts on Surface: + present, – absent

GR—Pecked and Ground Stone Industry Artefacts on Surface: + present, – absent

HR—Heat Retainers on Surface: + present, – absent

Cond. Rate—Site Condition Rating for Significance Assessment (chapter 6; table 24)

Size Rate—Site Size Rating for Significance Assessment (chapter 6; table 24)

Art Rate—Surface Artefact Frequency Rating for Significance Assessment (chapter 6; table 24)

Div. Rate—Diversity of Contents Rating for Significance Assessment (chapter 6; table 24)

Rare Rate—Rarity of Site Type Rating for Significance Assessment (chapter 6; table 23)

Rate Score—Significance Assessment Ratings Score: sum of Size Rate, Art Rate, Cond. Rate, and Div. Rate, or for rare site types the sum of Rare Rate and Cond. Rate; a '+' beside a score indicates a minimum score for a site, given the available information (e.g. where the site record form indicates that stone artefacts are present, but not how many, a score of '1+' was awarded for Art Rate).

Signif.—Archaeological Significance:

Low, Site has little potential to contribute to the understanding of the precontact period in the study area

Mod., Site has the potential to contribute to the understanding of the precontact period in the study area

High, Site has a high potential to contribute to the understanding of the precontact period in the study area